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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 33592, 33923, 33952, 34491, and 34492.

33141 FLUOROMETRIC DETERMINATION OF SCANDIUM WITH 5,7-DICHLOROOXINE. Nishikawa, Yasuharu; Hiraki, Keizo (Kinki Univ., Osaka). Nippon Kagaku Zasshi, 90: 483-6(May 1969). (In Japanese).

The fluorescent characteristics of Sc complexes with oxine, 5-7-dihalogenooxines (5,7-dichlorooxine, 5,7-dibromooxine, 5,7-diiodooxine), and 2-methyloxine were studied to investigate the possibility of fluorometric determination for Sc. 5,7-Dichlorooxine was found the most effective reagent for Sc determination. The procedure is as following: To 20 ml of the sample solution containing $\lesssim$10 μg Sc^{3+}, 0.25 ml of 0.2% 5,7-dichlorooxine, and 5 ml of 20% ammonium chloride solution were added. The solution was then adjusted to pH 9.5 with aqueous solution of NH_3. The mixture was extracted with 25 ml of chloroform by shaking for 3 min, the organic phase was centrifuged, and the fluorescence intensity of the phase was measured. The result showed 0.2 to 10 μg Sc can be determined within 3% error. The presence of Al, Y, La, and Lu introduces positive errors. These interferences were removed by separating Sc with TTA extraction method. There was no interference from 100 times as much Th for the determination of 0.5 μg Sc. This method may be applied to the analysis of rocks and minerals that contain 10^{-3} to 10^{-4}% Sc. (NSA of Japan)

33142 SPECTROPHOTOMETRIC DETERMINATION OF URANIUM(VI) WITH ARSENAZO III AFTER SEPARATION FROM THORIUM BY EXTRACTION. Onishi, Hiroshi; Toita, Yukio (Japan Atomic Energy Research Inst., Tokai). Bunseki Kagaku, 18: 592-5(May 1969). (In Japanese).

The separation of U from Th by triisooctylamine (TIOA) extraction and photometric determination of U(IV) with Arsenazo III has been described previously. In the present work, this extraction method has been simplified by washing twice the organic phase with 5M HCl. Uranium(VI) is then back-extracted with 0.3M HCl, and is determined with Arsenazo III at pH 1.5 to 2.0 and 650 nm without evaporating the back-extract, treating the residue with HNO_3 and $HClO_4$, and reducing U(VI) with Zn. By this method 20 μg of U can be separated from 40 mg of Th and determined with Arsenazo III. Small amounts of Zr, Al, Fe, Gd, and common anions do not interfere. When trioctylamine (TNOA) instead of TIOA in xylene is used under the same conditions, 20 μg of U can be separated from 60 mg of Th and determined with Arsenazo III. (NSA of Japan)

Chemical Procedures

Refer also to abstract 34057.

33143 (CNEA-241) DIRECT DETERMINATION OF URANIUM (VI) WITH Fe (II) BY AMPEROMETRIC TITRATION. Garcia, E. E.; Botbol, M.; Casabe, J. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1968. 11p. (In Spanish). Dep.

A polarographic study of U(VI) and Fe(II) systems showed that it was possible to use the anode wave from the oxidation of Fe(II) for the direct determination of U(VI). The parameters affecting the procedure, such as means of titration, type of electrode, treatment of the electrode, and effect of some foreign ions, were studied. The procedure was applied to U(VI) quantities between 5 and 55 mg with satisfactory results. (J.S.R.)

33144 (NP-17895) MASS SPECTROMETRY LABORATORY CHECK PROCEDURES ON HEU INPUT MEASUREMENTS. Bokelund, H. (European Company for the Chemical Processing of Irradiated fuels, Mol (Belgium)). Feb. 1969. 19p. (ETR-237). Dep.

The amounts of total uranium and of ^{235}U fed into the Eurochemic Plant are found from measurements of the volume/weight of the feed batches and from input analyses of samples drawn from these batches. Isotopic dilution mass spectrometry was used to find the concentration and the isotopic composition of uranium. Procedures used in the mass spectrometric laboratory during the reprocessing of highly enriched uranium (HEU) to obtain independent checks on the input results are presented. These procedures provide checks on the percentage of ^{235}U in each batch and the total amount of uranium per reactor charge. The $^{235}U/^{236}U$ data obtained are plotted to check the consistency of the different batches making up a reactor charge. Regression analyses on these graphs show that the precision of the ^{235}U percentage as found from such consistency lines is about 0.06 absolute percentage points. This error agrees with the measurement error, which in turn is 0.07 absolute percentage points (standard deviation of a single measurement). A calculated value for total uranium is compared with the quantities actually measured. During the two HEU campaigns dealt with, differences of 0.08% and 0.04% were found between total uranium measured and total uranium calculated. (auth)

33145 (UCRL-50630) COMMENTS ON SOME OF THE PHYSICAL CHEMICAL QUESTIONS ASSOCIATED WITH THE ANALYSIS OF WATER IN EARTH MATERIALS. Catalano, Edward (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 1969. 14p. Dep. CFSTI.

A discussion of various physical chemical questions associated with the quantitative determination of water in earth materials is presented. A pseudothermodynamic approach to the binding of water in various types of earth materials is also presented. Emphasis is placed on the fact that as pore, crack, or hole sizes approach molecular dimensions, the interaction energy of water with the host material can become very large. A scale of interaction energies is suggested that would be useful for specifying operationally relevant analyses in earth materials. (auth)

33146 MODERN ASPECTS OF MASS SPECTROMETRY. Proceedings of the Second NATO Advanced Study Institute of Mass Spectrometry on Theory, Design, and Applications, Held July 1966 at the University of Glasgow, Glasgow, Scotland. Reed, Rowland I. (ed.). New York, Plenum Press, 1968. 398p. $12.50. (CONF-660729).

Papers were presented on the following subjects: development of mass spectrometry in relation to gas-liquid chromatography; applications of low-cost mass spectroscopy; laser microprobe sampling and other new TOF mass spectrometer developments; the quadrupole mass spectrometer and some recent applications; the principle and application of a vacuum spark source mass spectrometer to the analysis of solids; metastable ions in mass spectra; mass spectrometric investigation of amino acids and peptides; pyrolysis, photolysis, and electronolysis; determination of high-temperature solution thermodynamics using a mass spectrometer; survey of the application of spark source mass spectrometry to the analysis of solids; mass spectrometry in

nuclear physics research; validity of selection rules in excitation and ionization collision processes; quantum chemical aspects of fragmentation mechanisms in mass spectrometry; ionization and dissociation processes; and mass spectrometry data center. Author and subject indexes are included. (J.G.B.)

33147 MICRODETERMINATION OF THORIUM. Thakur, R. D.; Agrawal, R. P. (Univ. of Allahabad, India). Microchem. J., 14: 298-301(June 1969).

Thorium was determined titrimetrically by dissolving the complex, formed by boiling thorium nitrate and sodium rhodizonate together, in dilute H_2SO_4. The dissolved complex in acid solution was titrated against standard ceric sulfate solution using N-phenylanthranilic acid as indicator. Complex is formed in the ratio of 1: 2. Maximum error is 0.9%. The range in which thorium was estimated varied from 11.2663×10^{-4} to 45.0752×10^{-4} mg/liter. Interference by certain metal ions was observed. (auth)

33148 SOLVENT EXTRACTION–ABSORPTIOMETRIC DETERMINATION OF NIOBIUM IN STEELS WITH BROMOPYROGALLOL RED. Ramakrishna, T. V.; Rahim, S. A.; West, T. S. (Imperial Coll. of Science and Tech., London). Talanta, 16: 847-53(July 1969).

A simple and rapid method is described for the determination of niobium in steel with Bromopyrogallol Red. After dissolution of the sample, niobium is extracted along with iron from concentrated hydrochloric acid into isopentyl acetate. Niobium and iron are stripped into an aqueous solution containing sodium acetate, and EDTA, ammonium chloride, tartaric acid, and Bromopyrogallol Red are added to complex the niobium. The niobium–Bromopyrogallol Red complex, along with excess of reagent, is extracted into isopentyl acetate containing di-n-octylmethylamine, and measured absorptiometrically at 610 nm. The molar absorptivity is 2.50×10^4 and Beer's law is obeyed up to 27 μg of niobium. The method is free from interferences and can be applied to the analysis of samples containing as little as 0.01% niobium. (auth) (UK)

33149 COMPLEXOMETRIC DETERMINATION OF MAGNESIUM, CALCIUM, STRONTIUM, AND BARIUM IN THE PRESENCE OF IRON AND CHROMIUM. Krleza, F. (Univ., Sarajevo, Yugoslavia). Croat. Chem. Acta, 41: 9-13(1969). (In German).

The determination of Ca^{2+}, Sr^{2+}, Ba^{2+}, and Mg^{2+} in the presence of Fe^{3+} or Cr^{3+} was investigated by means of complexometric titration. The influence of Fe^{3+} and Cr^{3+} was eliminated by masking with glycerin, and pH range and indicators applied are described for each particular case. Relative standard errors when iron was present were found to be 0.16 to 0.55% and when chromium was present were 0.08 to 0.85%. The investigations were carried out in the concentration range of Me^{2+} 1.16×10^{-3} to 1.1×10^{-2} M. (auth)

33150 ISOTOPIC ANALYSIS OF ARGON WITH A LOW BACKGROUND MASS SPECTROMETER. Miyake, Hiroshi (Kobe Univ., Japan). Kobe Shosen Daigaku Kiyo, Dai-2-Rui, Kokai, Kikan, Rigaku-hen, No. 16, 101-8(Mar. 1969). (In Japanese).

A high-sensitivity mass spectrometer was constructed with an ion source improved to provide very low background. The improved ion source was a Nier type, which had a mesh ionization chamber for the operation in static mode. A (BaSrCa)O coated filament was used as an electron source and made it possible to decrease the background of hydrocarbon because of its low electron emission temperature. Electrons were constrained in a narrow beam in order to decrease the surface phase ions emitted from the metal surface by electron bombardment. The procedure to determine the isotopic abundance of very small amount of Ar was studied. (NSA of Japan)

33151 SPECTROPHOTOMETRIC DETERMINATION OF VANADIUM AND NIOBIUM: XYLENOL ORANGE AS A CHROMOGENIC REAGENT. Agarwala, Badri Vishal; Dey, Arun K. (Univ. of Allahabad, India). Mikrochim. Acta, No. 3, 664-7(1969).

The formation of red chelates of vanadium(V) and niobium(V) with Xylenol Orange (DCAC) having λ_{max} at 490 nm (at pH 5.0) and 530 nm (at pH 5.5) is reported. The color formation was applied to the spectrophotometric determination of metal ions. The color was found to be stable between pH 3.5 to 6.5 and 2.0 to 7.0, respectively. The sensitivity of the reagent is 0.051 μg/cm^2 of vanadium and 0.093 μg/cm^2 of niobium. Maximum color intensity was found for Nb–DCAC chelate at pH 5.5 whereas no appreciable change was found for V–DCAC chelate between pH 4.5 and 6.5. (auth)

33152 COMPLEXOMETRIC DETERMINATION OF RARE EARTHS IN AQUEOUS SOLUTION. Sangal, Satendra P.; Agarwala, Badri V.; Dey, Arun K. (Univ. of Allahabad, India). Mikrochim. Acta, No. 3, 660-3(1969).

Complexometric determinations of praseodymium, neodymium, and samarium as representative members of the rare earths with Alizarin Red S, Thoron, and Murexide as chelatochrome indicators were investigated. Optimum pH range, concentration range, and other conditions required for the analysis of these metals were determined. (auth)

33153 INERT ATMOSPHERE EXCITATION: A COMPLETE SPECTROGRAPHIC QUALITATIVE ANALYSIS SCHEME. Caton, Gloria Magliane. Contract W-7405-eng-82. Ames, Iowa, Iowa State Univ., 1968. 123p. (IS-T-238).

Thesis.

A practical, spectrographic qualitative analysis scheme, which in principle allows the detection of all elements except He in a sample, was developed. The excitation scheme consists of exciting briquettes (formed from a blend of the powdered sample and a conducting electrode material) with a high-voltage spark in a noble gas supporting atmosphere. Studies of the influence of various experimental parameters on the effective excitation of the halogens led to the selection of the following excitation conditions: a He atmosphere was chosen in preference to Ar; pressures of 260 to 760 torr in He were equally satisfactory (400 torr was selected); graphite was selected as an electrode material in preference to Au or Ag; the use of two sample briquettes was superior to the conventional sample electrode and counter-electrode system; the optimal analytical gap separation was 1.5 mm; and electrical parameters of 0.0037 μf, 25 μh, and residual resistance in the high-voltage spark source were chosen. This excitation technique was extended to include as many elements in the periodic table as possible, with the result that the sensitive lines and corresponding detection limits of 77 elements (the radioactive and synthetic elements, the noble gases, and C were excluded) were determined. The detection limits for the halogens and S are in the range of 0.02 to 0.09%. The elements O and H can be estimated down to 0.4%, while N can be detected down to 0.002%. The detection limits for the alkaline earth elements range from less than 0.000008 to 0.0002% and for the alkali metals from 0.0001 to 0.01%. With the exception of Hf, W, Ir, Te, U, Nd, and Sm the remaining elements had detection limits of 0.01% or less. (Disser. Abstr.)

33154 MICRODETERMINATION OF ZIRCONIUM IN MARINE ENVIRONMENT. Sastry, V. N.; Krishnamoorthy, T. M.; Sarma, T. P. (Bhabha Atomic Research Centre, Bombay). Curr. Sci. (India), 38: 279-81(June 20, 1969).

A method was developed for estimation of Zr in the various matrices of marine environment. Coprecipitation of zirconium on ceric iodate and colorimetry using Alizarin Red-S were used to determine the Zr. It was concluded that a good part of Zr entering the seas finds its way into the sediments rather than into the biological species. (M.C.G.)

33155 X-RAY FLUORESCENCE ANALYSIS OF THORIUM AND URANIUM IN GRANITIC ROCKS. Borchert, Werner; Donderer, Erich (Technische Hochschule, Munich). Neues Jahrb. Mineral., Abh., 110: 142-58(1969). (In German).

A method is described for the quantitative determination of Th and U in granitic rocks. It is based on treatment of the analyzate with a $HF-HClO_4-H_2SO_4$ mixture and decomposition of the residue with HF in an autoclave at 400°C. After reduction of UO_2^{2+} to U^{4+} in a reduction vessel filled with Cd powder, the solution drops into a hypophosphate solution, where U and Th are coprecipitated with Zr. The precipitates are filtered and the elemental analysis performed on them by x-ray fluorescence, using the addition method. The maximum expected error for a single measurement for Th or U content up to 10 ppM is 15%; for contents over 10 ppM it is less than 8%. The method was used on 20 samples from the Hauzenberger Massif in Bavaria; Th values were found to vary between 10.7 and 52.9 ppM; U values varied between 3.9 and 9.8 ppM. (BBB)

Radiometric Procedures

Refer also to abstracts 33243, 33275, 33345, and 34118.

33156 THE PLUTONIUM CONTENT OF IRRADIATED FUEL FROM POWER REACTORS. Roach, Kenneth E. (Southern Nuclear Engineering, Inc., Dunedin, Fla.). Reactor Fuel-Process. Technol., 12: 217-24(Spring 1969).

Information on the measured point data on the plutonium content of irradiated fuel is presented, results from calculations based on presently accepted design methods are compared with measured data, and measured data on PWR fuel are compared with predictions made for water reactors of current design. In general, calculations of the plutonium content of irradiated fuel were in good agreement with available measurements. (M.C.G.)

33157 RADIOMETRIC METHODS FOR THE DETERMINATION OF FLUORINE. A REVIEW. Foreman, J. K. (Lab. of the Government Chemist, London). Analyst, 94: 425-34(June 1969).

A review is presented under the following headings: Introduction; Isotopes of fluorine, (^{18}F, ^{20}F); Radiometric determination of fluorine (Activation methods, Neutron activation, α-Particle activation, Activation with ^{3}He nuclei, Proton activation, γ-Ray activation); Indirect methods; and Isotope dilution. (auth) (UK)

33158 A METHOD OF, AND A DEVICE FOR, DETERMINING THE ISOTOPE CONTENT OF A URANIUM COMPONENT. Bruno, Charles; Laubuge, Robert; Pierre, Edmond; Samson, Monique (to Commissariat a l'Energie Atomique). British Patent 1,154,825. June 11, 1969. Priority date Dec. 14, 1966, France.

Uranium-238 can be determined nondestructively in an exposed U component, such as a fuel element, by counting, at the surface of the component, the β radiation with an energy greater than a threshold (about 500 keV) selected for eliminating β radiation due to ^{235}U and comparing the measured results with those obtained from components with known ^{238}U content. The device for carrying out the determination consists of a detector sensitive to β radiation only, a box with walls thicker than the depth to which β radiation will penetrate the material of which the box is made, and having an orifice defining a solid measuring angle, and an amplifier and counting circuit connected to the detector. The counting circuit includes a discriminator for eliminating pulses corresponding to β rays with energy less than or equal to the threshold. (B.L.M.)

Activation Procedures

33159 (BNL-13740) NEUTRON ACTIVATION ANALYSIS OF POTSHERDS FROM KNOSSOS AND MYCENAE. Harbottle, Garman (Brookhaven National Lab., Upton, N. Y.). [1968]. 24p. Dep. CFSTI.

Twenty sherds of each of two groups, representing pottery finds at Mycenae and Knossos, were analyzed by neutron activation for ten elements. The results indicate that this procedure can be a useful complement to the emission spectrographic method of analysis, both as a check on the latter and as a means of extending the range of elements determinable to considerably lower concentrations. One sample in each of the two groups definitely seems not to belong to its supposed compositional category: with these exceptions, the groups established by emission spectrographic analysis appear to retain their homogeneity when elements present at a lower concentration level are determined. (auth)

33160 (KR-131) RAPID DETERMINATION OF ALUMINIUM IN ROCKS BY REACTOR NEUTRON ACTIVATION ANALYSIS. Steinnes, E. (Instituut for Atomenergi, Kjeller (Norway)). Jan. 1969. 9p. Dep.

A simple and rapid method for determination of aluminum in silicate rocks by reactor neutron activation and gamma spectrometry is presented. The method was tested on some standard rocks, and the results are in agreement with previous values obtained by the conventional gravimetric method, except for samples very low in Al, where the neutron activation results are lower. For samples with about 15% Al_2O_3, the precision is of the order 1 to 1.5%, and the accuracy of the mean values about 1%. Corrections must be applied for interference from silicon and manganese. (auth) (Norway)

33161 A STUDY OF THE PERSPIRATION TEST BY NEUTRON ACTIVATION UNDERGONE BY ADULTS. Voog, R.; Millet, M.; Rambaud, P.; Bonnin, Jr.; Berard, M.; Cabanel, G. (Centre d'Energie Nucleaire, Grenoble, France). Ann. Biol. Clin. (Paris), 27: 53-63(Jan.-Feb. 1969). (In French).

The amount of electrolytes in the perspiration of an adult was determined by a biochemical quantitative analysis and also by neutron activation analysis. A comparison of the results obtained by the two techniques demonstrates the validity of the perspiration test carried out by the classic method of analysis. Repetition of tests undergone by the same person indicates that there exists a stability of the concentration of electrolytes in the perspiration of adults. (auth)

33162 ACTIVATION ANALYSIS OF HIGH PURITY METALS. Revel, Gilles (CNRS-CECM, Vitry-sur-Seine, France). Ind. Chim. Belg., 33: Spec. Issue, 145-50(1969). (In French).

After a brief review of the principles and the chief advantages of activation analysis, different possibilities for application to high-purity metal analysis are noted. Irradiation must be carried with different particle fluxes depending on the nature of the sample and the characteristics of the isotopes studied. Neutron activation analysis serves as the most specific and the most convenient method, and thus it is the most widely used; certain analytical systems allow analysis of 50 impurities in a single 1-g sample. These analyses are completed after irradiation with fast neutrons, γ rays, and charged particles, and allow definition of the content of metals that have a total impurity content on the order of 10^{-5} to 10^{-7}; limits of detection are tabulated for each of the elements, and are generally on the order of 10^{-8} to 10^{-13} depending on the element analyzed. (BBB)

33163 NEUTRON ACTIVATION ANALYSIS OF TRACE ELEMENTS IN SKIN. I. COPPER IN NORMAL SKIN. Molokhia, Mohamed; Portnoy, Benjamin (Manchester and Salford Hospital for Skin Diseases, Eng.). Brit. J. Dermatol., 81: 110-14(Feb. 1969).

A neutron activation analysis technique was devised to estimate Cu levels in epidermis and dermis using no more skin than is taken at an average biopsy (about 0.01 g). Specimens of skin were taken from the abdominal region of adults, apparently free of skin diseases at biopsy or within 24 hr after death from subjects dying in accidents. The samples were taken using stainless steel instruments to avoid contamination with Cu. After the samples were dried to a constant weight, samples weighing 5 to 10 mg each were wrapped in pure Al foil and irradiated, together with a standard solution of Cu placed inside a silica ampoule, for 8 to 12 hr inside a Pye-AFM 100-KW reactor in a thermal neutron flux of 3.6×10^{13} n/cm^2/sec. A slight modification was introduced in the method of Cu separation originally adapted for tooth enamel. To achieve complete destruction of the organic matter in the skin, the samples were boiled, with Cu carrier added, in a mixture of H_2SO_4 and HNO_3 (1:1) instead of HNO_3 alone. The samples were counted for their Cu radioactivity using a G-M counter and compared with the standard. The same pattern of Cu content was found in the biopsy and autopsy groups. Copper content of epidermis ranged between 2.23 and 15.10 μg/g with a mean of 7.05 μg/g. This is more than twice the concentration of Cu in dermis, which was found to range from 1.88 to 6.10 μg/g with a mean of 3.09 μg/g. (BBB)

33164 DETERMINATION OF COPPER AND MANGANESE IN THE HUMAN LIVER BY NEUTRON-ACTIVATION ANALYSIS. Ueda, Hideo; Iwase, Toru (Tokyo Univ.). Kaku Igaku, 5: No. 3, 157-64(Oct. 1968). (In Japanese).

Neutron activation analysis of Cu and Mn was performed both by nondestructive (^{66}Cu) and chemical separation (^{64}Cu and ^{56}Mn) methods on biopsy and autopsy liver samples obtained from 10 cases of Wilson's disease, 5 cases of hemochromatosis, and 8 normal cases. Liver samples (1 to 100 mg dry weight) were irradiated for 10 min to 4 hr using TTR-1 100 kW swimming pool reactor with a thermal neutron flux of 3×10^{11} n/cm^2 sec. Copper was separated with almost 100% yield by internal electrodeposition technique, and then Mn with 90% yield by the usual precipitation method. Comparison between nondestructive and chemical separation methods for Cu analysis showed good correlation in Wilson's autopsy liver specimens stored in formalin. However, fresh liver specimens obtained by needle biopsy could be analyzed only by using the chemical separation method, because of the presence of a large amount of Na. The hepatic Cu content was found to be abnormally increased in Wilson's disease samples (88 to 720 μg/g dry weight) and also in hemochromatosis (100 to 2500 μg/g), normal range being 2 to 58 μg/g. The amount of hepatic Mn in hemochromatosis was 4.1 to 17 μg/g dry weight, showing significant increase compared with normal range of 1.1 to 3.4 μg/g. Activation analysis of trace elements in the human liver proved to be useful for medical research and diagnosis. By the combination of rapid chemical separation method with thermal neutron irradiation even the needle biopsy sample (e.g., 1 mg) could be successfully analyzed. (NSA of Japan)

33165 NEUTRON ACTIVATION ANALYSIS OF UPPER LAYER PAINT CHIPS OF CAR. ITS ADVANTAGE OVER EMISSION AND INFRARED SPECTROPHOTOMETRY. Niwase, Takeshi; Koxuka, Hiroshi (National Research Inst. of Police Science, Tokyo). Kagaku Keisatsu Kenkyusho Hokoku, 21: 275-81(Dec. 1968). (In Japanese).

Twelve samples of different colored paints were chosen from the upper paint layer of a car made for crime investigation. These samples were analyzed by emission and infrared spectrophotometry and neutron activation analysis. The results of these analyses were compared with each other and the advantages and disadvantages of these three methods are discussed. Emission spectrophotometry was a simple and rapid method but inferior in quantitative analysis and not suitable for analysis of analogous samples. In the infrared spectra of all the samples, specific absorbences of melamine alkyd resin were observed and only slight differences were shown in the field of fingerprints.

Neutron activation analysis provided much useful information. (NSA of Japan)

33166 ESTIMATION OF THYROID IODINE CONTENT BY THE OCCUPANCY PRINCIPLE. Riviere, R. (Service Hospitalier Frederic Joliot, Orsay, France); Comar, D.; Kellershohn, C.; Orr, J. S.; Gillespie, F. C.; Lenihan, J. M. A. Lancet, 1: 389-90 (Feb. 22, 1969).

A method employing ^{129}I and activation analysis was developed for determination of thyroid iodine content. The method exploits the occupancy principle and the unusual properties of ^{129}I, suitable both as a radioactive tracer, for long-term studies, and as a stable tracer, when detected by activation analysis. The occupancy principle can be applied to thyroid and plasma activities with ^{129}I over a period of a year or more. The iodine content estimated in this way, because of its participation in the flow through the thyroid gland, includes all of those fractions of which a measurable part is gained and lost in the course of a year; in other words, it represents all of the iodine which is of any clinical significance and probably the total iodine content of the gland. In an experiment to develop these possibilities, a single dose of 325 μg ^{129}I (0.05 μCi) was given by mouth to a healthy volunteer. The changing quantities of ^{129}I in the thyroid were estimated thereafter by external counting of the associated 29.8-keV characteristic x-ray emission of xenon. Standardization of thyroid uptake cannot be done directly because of the strong absorption at this energy. A small dose of ^{131}I given simultaneously was used to determine the true percentage uptake of the ^{129}I tracer dose; ^{131}I is better for this purpose and was used in subsequent work. The estimation of ^{129}I in blood was performed by thermal neutron-activation analysis; the total radiation dose incurred by the thyroid was 0.6 Rad. The activity-time curves for the thyroid and plasma are shown. (BBB)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 33214, 34114, and 34888.

33167 (ANL-7446) TWO-CENTER-EXPANSION SCF CALCULATIONS ON ACETYLENE AND ETHYLENE. Janiszewski, F. J.; Lykos, P. G.; Wahl, Arnold C. (Argonne National Lab., Ill.). May 1968. Contract W-31-109-eng-38. 80p. Dep. CFSTI.

The determination of molecular structure using the two-center-expansion (TCE) method in which expansion basis functions are based on only two centers of polyatomic system was studied. Since acetylene and ethylene molecules have the same heavy atom skeleton with an increasing number of protons, they were selected to test the method. A completely optimized TCE, self-consistent-field (SCF), molecular-orbital (MO) wave function was obtained for acetylene using the Hartree-Fock-Roothaan procedure. The final results obtained were -76.7240 hartrees for the total energy and 10.86 eV for the ionization potential. The corresponding experimental values are -77.3605 hartrees and 11.41 eV, respectively. The total energy results obtained were -77.5537 hartrees for planar ethylene. The experimental value is -78.6166 hartrees. Analysis of the wave functions and molecular properties indicated that those orbitals not involving a carbon-hydrogen bond in acetylene and ethylene were well represented, but those involving the bond were not well represented. The conclusion reached was that for systems of the type H-A-B-H or A-B-H, the method was useful and practical; however, for the general class of molecules H_m-A-B-H_n, the method was not practical. (D,H,M.)

33168 (EUR-4228) SOLUBILITY OF TERPHENYLS AND OM_2 MIXTURES IN PURE AND TECHNICAL SOLVENTS. Mosselmans, G.; Nienhaus, J. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Nov. 4, 1968. 53p. Dep.

The solubility of terphenyls and the OM_2 mixture in pure and technical solvents was studied. Results are presented on curves where the weight percent terphenyl or OM_2 versus temperature is plotted. The results allow some considerations about the influence of the structure and the nature of functional groups on the solvent ability. Finally a selection of solvent was made for decontamination purposes. (auth) (Luxembourg)

33169 (JUL-573-RG) COMPARATIVE COST CACULATIONS FOR THE SYNTHESIS OF METHANOL AND BENZENE FROM WATER GAS. Barnert, Heiko (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Jan. 1969. 33p. (In German). Dep.

Comparative cost calculations for production of methanol and benzene by reactions of carbon monoxide and hydrogen are given. The hydrogen and carbon monoxide were obtained by distillation of soft coal using heat from a high-temperature nuclear reactor. (M.C.G.)

33170 DEUTERIOHYDRATES OF CYCLOPROPANE. Hafemann, Dennis R.; Miller, Stanley L. (Univ. of California, San Diego, La Jolla). J. Phys. Chem., 73: 1398-1401(May 1969).

The thermochemical constants of the two clathrate deuteriohydrates of the cyclopropane-D_2O system were determined by pressure vs temperature measurements. The deuteriohydrate formulas are $C_3H_6 \cdot 7.8D_2O$ and $C_3H_6 \cdot 17.2D_2O$, corresponding to the structure I 12-Å and structure II 17-Å hydrates, respectively. Below 0°, the deuteriohydrate dissociation pressures are higher than the hydrate dissociation pressures, but above 0° the deuteriohydrate dissociation pressures are lower than the hydrate dissociation pressures. The structure I deuteriohydrate is less dense than liquid D_2O, but the structure I hydrate is more dense than liquid H_2O. An explanation is offered for this anomaly. A comparison of the free energies of empty clathrate lattice formation from H_2O and D_2O ice shows that the deuteriohydrate lattice is only slightly more unstable than the hydrate lattice. (auth)

33171 OXYGEN ISOTOPE PARTITION FUNCTION RATIO OF WATER AND THE STRUCTURE OF LIQUID WATER. O'Neil, James R.; Adami, Lanford H. (Geological Survey, Menlo Park, Calif.). J. Phys. Chem., 73: 1553-8(May 1969).

By means of the CO_2-equilibration technique, the temperature dependence and absolute values of the oxygen isotope partition function ratio of liquid water were determined, often at 1° intervals, from -2 to 85°C. A linear relationship between ln (Q_2/Q_1) (H_2O) and T^{-1} was obtained that is explicable in terms of the Bigeleisen-Mayer theory of isotopic fractionation. The data are incompatible with conventional, multicomponent mixture models of water because liquid behaves isotopically as a singly structured homogeneous substance over the entire temperature range studied. A two-species model of water is proposed in which approximately 30% of the hydrogen bonds in ice are broken on melting at 0°C, and in which this percent of monomer changes by only a small amount over the entire liquid range. Because of the high precision and the fundamental property determined, the isotopic fractionation technique is particularly well suited to the detection of thermal anomalies. No anomalies were observed and those previously reported are ascribed to underestimates of experimental error. (auth)

33172 SECONDARY DEUTERIUM ISOTOPE EFFECT IN THE IONIZATION OF TRIMETHYLAMINE-d_9 IN WATER. Northcott, D.; Robertson, R. E. (National Research Council, Ottawa). J. Phys. Chem., 73: 1559-63(May 1969).

The temperature dependence of the ionization constant of trimethylamine and trimethylamine-d_9 were determined in water at 5° intervals over the temperature range 0 to 45°C by a conductance method. The total isotope effect is shown to be due to $\delta_1\Delta H$—a result consistent with a simple zero point energy explanation. The temperature coefficient of the heat capacity of ionization was shown to be small and positive. (auth)

33173 REACTIONS IN THE SYSTEM $TaCl_5$-UCl_4-KCl. Krokhina, A. G.; Morozov, I. S. Zh. Neorg. Khim., 14: 1401-6(May 1969). (In Russian).

The reactions of chlorides of tantalum, uranium, and potassium on their combined crystallization from melts were studied. The liquid surfaces of the ternary system KCl-UCl_4-$TaCl_5$ were constructed. The relation of the pressure of the UCl_4 vapor over potassium hexachlorouranate to the temperature was determined and certain thermodynamic functions calculated. (tr-auth)

33174 INVESTIGATION OF THE CARBAMIDOSULFATE AND CARBAMIDOOXALATE COMPOUNDS OF THORIUM BY THE METHOD OF INFRARED SPECTROSCOPY. Petrov, K. I.; Molodkin, A. K.; Saralidze, O. D.; Ivanova, O. M. Zh. Neorg. Khim., 14: 1227-31(May 1969). (In Russian).

The absorption spectra of a series of carbamidosulfate and carbamidooxalate compounds of thorium were studied. It was established that the compounds must be considered as mixed complex compounds that contain an internal sphere, along with the sulfate or oxalate groups, coordinated through the oxygen of the carbamide molecule. (tr-auth)

33175 URANYL ACETOTHIOCYANATE COMPLEXES. Shchelokov, R. N.; Orlova, I. M. Zh. Neorg. Khim., 14: 1436-7 (May 1969). (In Russian).

In a continuing investigation of the complex chemical reactions of the thiocyanate ion with the uranyl ion, reactions of uranyl

diacetate complexes with the thiocyanate ion were studied. The reactions were complex and led to the formation of $[UO_2(CH_3COO)_2(NCS)]^-$ and $[(UO_2)_3(CH_3COO)_7(NCS)_2]^{3-}$ or to the precipitation of the triacetatouranyl ion $[UO_2(CH_3COO)_3]^-$. (M.C.G.)

33176 ANODIC DISSOLUTION STUDY OF URANIUM ALLOYS IN FUSED SALTS. Fondanaiche, Jean-Claude (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France). Bull. Soc. Chim. Fr., No. 5, 1579-83(May 1969). (In French).

The mechanism of the anodic dissolution of alloys is generally studied by observing the dissolution potential under various conditions. In this case the analyses of the anodic sludges were undertaken. Wastes formed on the uranium–molybdenum, uranium–niobium, and uranium–zirconium alloys in the course of their electrochemical dissolution in melted chlorides, correspond to uranium alloys weakened enough for the slow extraction of this metal. Analysis has shown that the influence of impurities such as carbon and nitrogen can give compounds nobler than uranium. (auth)

33177 ADSORBENT PROPERTIES OF MIXED OXIDES OF URANIUM AND THORIUM IN RELATION TO THE GASEOUS COMPONENTS IN THE OXIDATION REACTION OF CARBON MONOXIDE. Brau, Guy; Claudel, Bernard (Institut de Recherches sur la Catalyse, Villeurbanne, France). J. Chim. Phys., 66: 715-23(1969). (In French).

Studies of the chemisorption of O_2, CO, and CO_2 gases and of their interactions in adsorbed phase show that carbon monoxide oxidation mechanism catalysed by uranium–thorium mixed oxides, proceeds through direct oxidation and reduction of the catalytic surface, and that the elementary step determining the rate of this catalysis must be the reduction of the solid by carbon monoxide. (auth)

33178 THE OXYFLUORIDE OF TRIVALENT THORIUM, ThOF. STUDY OF THE DIAGRAM ThOF–ThO_2–ThF_4. Rannou, J. P.; Lucas, J. (CNRS, Rennes, France). Mater. Res. Bull., 4: 443-50(July 1969). (In French).

The oxyfluoride of trivalent thorium is formed by the reaction of the mixture: $Th + 2ThO_2 + ThF_4$ in a sealed nickel tube at 1200°C. ThOF has a fluorite-type lattice with random distribution of oxygen and fluorine, a = 5,685 Å. The solid solution, $ThO_{2-x}F_x$, is continuous. ThO_2 and ThOF dissolve ThF_4 to give cubic solid solutions with respective limits $ThO_{1.6}F_{0.8}$ and $ThO_{0.92}F_{1.35}$. A new oxyfluoride, $ThO_{0.5}F_{2.5}$, with $ThOF_2$ structure is prepared by reaction between ThF_4 and ThOF. (auth)

33179 EFFECT OF THE DEUTERIUM ATOM FRACTION ON THE STABILITY CONSTANT OF THE MAIN HYDROLYSIS PRODUCT OF THE BERYLLIUM ION. Kakihana, Hidetake; Maeda, Masunobu (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap., 42: 1458-60(May 1969).

The composition and the stability constants of the main hydrolysis species in the hydrolysis of beryllium ion, which is known to be $Be_3(OH)_3^{3+}$, were evaluated in 20 and 80% heavy water; and the variation in the stability constant with a variation in the deuterium atom fraction (0 to 0.8) was studied. Results show that the stability of the main hydrolysis product decreases gradually with an increase in the deuterium atom fraction. (D.H.M.)

33180 STUDY BY INFRARED SPECTROMETRY OF THE OXIDATION OF CARBON MONOXIDE CATALYZED BY A MIXED OXIDE OF URANIUM AND THORIUM. Pichat, Pierre; Brau, Guy (Institut de Recherches sur la Catalyse, Villeurbanne, France). J. Chim. Phys., 66: 724-9(1969). (In French).

The structure, formation conditions, and stability of the species obtained by the carbon oxides adsorption over a catalyst of general formula $U_xTh_{1-x}O_{2+y}$ submitted to various treatments have been determined by infrared spectrometry. The CO–CO_2, CO–O_2 interactions in chemisorbed phase are studied. From the results, the mechanism of catalytic oxidation of carbon monoxide is derived. Furthermore, it is shown that, if the hydroxyl groups are weakly fixed on the contact mass, several successive treatments by oxygen at 450°C are required to remove all carbonated impurities from the superficial layers of the solid. (auth)

33181 DEPENDENCE OF THE DEGREE OF DECONTAMINATION OF THE SURFACE ON THE SPECIFIC ACTIVITY AND THE pH OF THE CONTAMINATING SOLUTION. Miazek-Kula, Maria; Smal, Zbigniew. Pr. Cent. Inst. Ochrony Pracy, 17: 311-20 (1967). (In Polish).

The relation of the degree of contamination of surfaces of steel and vinidur to the specific activity and hydrogen index of the contaminating solution was investigated. Solutions that contained ^{32}P in the form of Na_2HPO_4, with specific activity 490 to 74, 49 to 7.4, and 4.9 to 0.7 μCi/ml and in addition $^{85+89}Sr$ in the form of $SrCl_2$, with specific activity of about 320, 32, 3.2, and 0.3 μCi/ml were used. Samples deactivated by submersion alternately in water, in 0.2N H_2SO_4 and in a solution containing 55% H_3PO_4, 20% H_2SO_4, 20% H_2O, and 5% CrO_3 steel were also deactivated electrolytically. It was established that the degree of surface decontamination depends on the hydrogen index of the contaminating solution during deactivation by submersion, but not by electrolysis. The results of the investigation on decontamination agreed with those on adsorption of radioactive isotopes of phosphorus and strontium. The influence of specific activity on the degree of decontamination of surfaces is insignificant for steel and only slightly greater for vinidur. (tr-auth)

33182 RADIOCHEMICAL STUDY OF SELF-DIFFUSION AND ISOTOPE-EXCHANGE IN AQUEOUS SOLUTIONS. PART 3. THE DEPENDENCE OF ISOTOPE-EXCHANGE BETWEEN Tl(I) AND Tl(III) IONS ON THE PERCHLORIC ACID CONCENTRATION. Gosman, Alexander; Sedlacek, Josef (Prague Technical Univ.). Z. Phys. Chem. (Leipzig), 240: No. 1-2, 26-35(1969).

An analysis of the method for determination of the rate of isotope exchange without analytical separation of the components and an analysis of the optimum initial conditions were performed. Isotope exchange in the system of 0.005 M $TlClO_4$ and 0.005 M $Tl(ClO_4)_3$ in 0.8 M $HClO_4$ and in that of 0.01 M $TlClO_4$ and 0.01 M $Tl(ClO_4)_3$ in 1.5, 2.5, and 3.5 M $HClO_4$ was investigated experimentally for the case of an ionic strength of I = 3.68 (adjusted by $NaClO_4$) at 25°C. The results, expressing the rate of isotope exchange in the Tl(I)–Tl(III) system as a function of perchloric acid concentration at constant ionic strength, are presented and discussed. (JPRS)

33183 MOLAR REFRACTIVITY AS A DIAGNOSTIC TOOL FOR DETERMINING COMPOSITION OF TRANSITION ELEMENT FLUORIDE COMPLEXES. Penneman, Robert A. (Los Alamos Scientific Lab., N. Mex.). Inorg. Chem., 8: 1379-84(July 1969).

The composition of alkali (and ammonium) fluoride complexes of the tetravalent d- and f-transition elements Zr, Ce, Th, U, and Pt can be determined from their molar refractivities, R. A simple linear rule applies: $R_{nAF \cdot MF_4} = nR_{AF} + R_{MF_4}$. The absolute value of the refractivity depends on the tetravalent element M and the mole ratio (n) of alkali fluoride (AF) to MF_4. The increment in refractivity per mole of a given alkali fluoride in the complex is a constant. For some 45 compounds it was found that R_{AF} is equivalent to R_{A^+} plus R_{F^-}, Fajans' refractivities for the aqueous ions. Thus, a close estimate of the molar refractivity for many compounds can be obtained by adding multiples of Fajans' aqueous refractivities for the alkali and fluoride ions to the measured refractivity of the tetrafluoride. The $R_{nAF \cdot MF_4}$ values for analogous compounds reflect the sequence $R_{CeF_4} > R_{UF_4} \approx R_{PtF4} > R_{ThF_4} > R_{ZrF_4}$. Additivity also applies to $R_{nAF \cdot MF_5}$ and $R_{nAF \cdot MF_6}$, the molar refractivities of trivalent and pentavalent fluoride complexes. A model for statistical treatment of refractivity data is given. (auth)

33184 INTERACTION BETWEEN URANIUM MONOSULPHIDE AND NITROGEN. Despotovic, Z.; Ban, Z. (Univ., Zagreb). Croat. Chem. Acta, 41: 25-9(1969).

The study of the process of interaction between nitrogen and nearly stoichiometric uranium monosulfide reveals at least three distinct stages. The first one (200 to 580°C) is characterized by limited interstitial dissolution of nitrogen in the lattice. At approximately 580°C, US starts to react with N_2 yielding uranium sulfonitride of the composition $U_2S_2N_y$. Above 1200°C $U_2S_2N_y$ decomposes into $U_2S_{2-x}N_y$. The x-ray powder diffraction method was used in order to derive the most probable atomic positions in the crystal structure of U_2S_2N. (auth)

33185 CHARACTERIZATION OF THE COMPLEXES OF URANIUM(VI) WITH DESFERRIOXAMINEMETHANESULFONATE (DESFERAL) BY ABSORPTION SPECTROPHOTOMETRY. Hafez, Mohamed; Patti, Francois (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France). Bull. Soc. Chim. Fr., No. 4, 1419-23(Apr. 1969). (In French).

Results obtained in complexing hexavalent uranium by desferrioxaminemethanesulfonate (Desferal), using absorption spectrophotometric analysis are reported. The ionic and the hydrolysis precipitate physicochemical states were studied. In the first case pH influence on the formation of complexes, molecular ratios at pH 4.5 and 7.5, and formation constants were determined. Hydrolysis precipitate conditions of solubilization by complex formation as a function of pH, aging of the precipitate, and precipitate-chelating agent contact time were studied. Comparison of the complexing efficiency of Desferal with DTPA clearly demonstrated a greater effect with DTPA (diethylenetriaminepentaacetic acid). (auth)

33186 PREPARATION AND CRYSTAL STRUCTURES OF DICESIUM BERKELIUM HEXACHLORIDE AND DICESIUM

SODIUM BERKELIUM HEXACHLORIDE. Morss, L. R.; Fuger, J. (Univ. of California, Berkeley). Inorg. Chem., 8: 1433-9 (July 1969).

Cs_2BkCl_6 and $Cs_2NaBkCl_6$ were prepared from aqueous solution on the scale of a few micrograms using the isotope ^{249}Bk. The crystal structures of these compounds were investigated by x-ray powder diffraction. Cs_2BkCl_6 is not isomorphous with Cs_2PuCl_6 and Cs_2CeCl_6, which exhibit trigonal symmetry, but has double the c axis of these compounds, with two molecules per unit cell. The hexagonal lattice parameters (95% confidence) are a = 7.450 (3) Å and c = 12.098 (5) Å. $Cs_2NaBkCl_6$ is face-centered cubic and isomorphous with the corresponding americium compound. The lattice parameter is a = 10.805 (3) Å; the crystal contains four molecules per unit cell. (auth)

33187 EFFECTS OF METAL SALTS ON POLYMERIZATION. VI. PHOTO AND THERMALLY CATALYZED POLYMERIZATION OF N-VINYLIMIDAZOLE IN THE PRESENCE OF METAL SALTS. Tazuke, Shigeo; Okamura, Seizo (Kyoto Univ.). J. Polym. Sci., Part A-1, 7: 851-64(Mar. 1969).

Polymerization of 2-methyl-1-vinylimidazole (MVI) and 2-ethyl-1-vinylimidazole (EVI) was found to be markedly photosensitized in the presence of oxidizing metal salts such as $UO_2(NO_3)_2$, $Ce(NH_4)_2(NO_3)_6$, $Hg(CH_3COO)_2$, $AgNO_3$; non-oxidizing metal salts such as Zn^{2+} did not act as photosensitizers. The interaction of monomer with a metal salt is discussed on the basis of infrared and electronic spectroscopy. This photopolymerization is very specific with respect to the kind of monomer. The polymerization of noncomplexing monomer (styrene) is not photosensitized by these metal salts. Consequently, photosensitized electron transfer between monomer and metal salt via complex formation is considered to be the most probable initiation mechanism. Cupric acetate and sodium chlorolaurate, act as linear terminators of growing radicals. The radical polymerizability of the zinc complex of MVI was studied by means of copolymerization with styrene. The reduction of the reactivity of MVI on complexing was explained by correlating with the spectroscopic observations. Because the polymerization system is heterogeneous, a detailed discussion was not possible. (auth)

33188 AN ELECTROCHEMICAL STUDY OF Yb(II) IN MOLTEN LiCl-KCl AND INVESTIGATION OF Bis (2-METHOXYETHYL) ETHER (DIGLYME) AS A SOLVENT FOR POLAROGRAPHIC STUDY OF ORGANIC COMPOUNDS. Clark, Gale Jefferson. Nashville, Vanderbilt Univ., 1968. 125p.

Thesis.

Conditions were established for the production of a black material that was first observed as one of the products of the electrochemical reduction of Yb(III) at a Pt electrode in fused LiCl-KCl eutectic at 450°C. This material was found to appear only in conjunction with electrochemical reduction of Yb(III) solutions at a Pt electrode. The black material was analyzed semi-quantitatively and found to contain Yb and Pt in approximately 2:1 ratio. Controlled potential electrolysis of Yb(III) solution at a pyrolytic graphite electrode produced almost total conversion to Yb(II), which was found to be stable in the fused salt. None of the black material was produced. Platinum metal would not react with the Yb(II) solution. Experiments with pure Yb metal showed it to be readily oxidized in the fused salt producing both Yb(II) and Yb(III). Three alternative explanations for the appearance of black material and other experimental evidence were considered. These were: disproportionation of Yb(II) in conjunction with Pt-Yb alloy formation, disproportionation of Yb(II) in conjunction with an adsorption phenomenon and subsequent Pt-Yb alloy formation, and reduction of Yb(II) via an unusual electron transfer process and alloy formation by Pt and Yb. Bis(2-methoxyethyl) ether was examined as a solvent for the polarographic study of organic compounds. A summary of the polarographic data obtained in these studies is given. There is reason to believe that the reductions produce radical ions in solution. The reduction potentials for various functional groups appeared in the order $SO_2SO_2 \leq SO_2S < SS$. The limitations of these correlations for this system are considered. (Disser. Abstr.)

33189 THE MECHANISM OF QUENCHING OF SODIUM RESONANCE RADIATION AND THE HYDROLYSIS OF O-CHLOROACETYLSALICYLIC ACID IN LIGHT AND HEAVY WATER. Tseng, Linda. Grand Forks, N. D., Univ. of North Dakota, 1968. 155p.

Thesis.

The chemical reactivity of excited and nonexcited Na with H_2 to form sodium hydride at various pressures and temperatures was studied. Since the experimental results indicated that at very low pressure, 50 mm Hg, and within the temperature range 100 to 200°C, neither excited nor nonexcited Na reacted with H_2, it was concluded that the quenching of Na resonance radiation by H_2 at temperatures below 200°C is not a chemical reaction. To investigate the transfer of electronic energy from excited Na to the quencher, H_2, to excite its rotational and/or vibrational energy levels, an attempt was made to detect a shift of wavelength in emitted resonance radiation, i.e., the Raman effect. Even though a definite amount of radiation was quenched, no shift in wavelength was detected. The experimental entropies of activation were calculated for the quenching process in the systems of Na^*-H_2, Na^*-D_2, Na^*-N_2 and Na^*-CO. These entropies also were estimated theoretically using statistical mechanics. For the Na^*-H_2 system, a comparison of the experimental and theoretical results indicated that both entropies of activation calculated using the triangular and linear models for the activated complex were close to the experimental value. This suggests that the mechanism of quenching involves first the formation of a Na^*-H_2 complex followed by internal quenching and dissociation into $Na + H_2$. This can be applied to the other systems as well. However, in all cases except hydrogen, the theoretical entropies based on a triangular complex were closer to the experimental values than results for the linear ones. By comparing the isotope effect of H and D, it was possible to test whether or not the Na^*-H_2 complex is linear or triangular. Using absolute rate theory to calculate the isotope effect, 3.00 was obtained for the linear complex and 1.87 for the triangular complex. The experimental value was 1.76. Apparently, the triangular complex is more favored than the linear model. The temperature effect on the hydrolysis of o-chloroacetylsalicylic acid in light and heavy water was investigated. The results indicated that the rates of hydrolysis of o-chloroacetylsalicylic acid in heavy water were about 55% slower than in light water even though the activation energies were about equal, 14 kcal/mole. This decrease in rate appears to be due to the entropy term rather than the activation energy. All entropies of activation were negative and differed by 1 to 2 eu in the two media. The major difference in entropies can be assumed to result from the extent of translational restriction when water is bound or released by the o-chloroacetylsalicylic acid. Calculations based on this hypothesis were compared to the experimental results and indicated that there was an increase of three units of water molecules bound in the neutral pH region and eight units in the acidic or basic pH regions when o-chloroacetylsalicylic acid goes from the ground state to its activated complex during hydrolysis. (Disser. Abstr.)

33190 THERMODYNAMIC INVESTIGATIONS. I. CRYOSCOPIC AND CALORIMETRIC INVESTIGATIONS OF BETAINE AND BETAINE HYDROCHLORIDE. II. THERMOCHEMISTRY OF COBALT AND NICKEL SULFATES. THERMODYNAMIC PROPERTIES OF $Co^{+2}(aq)$ AND THE COBALT OXIDATION POTENTIALS. III. THERMOCHEMISTRY AND OXIDATION POTENTIALS OF THE PLATINUM GROUP METALS AND THEIR COMPOUNDS. IV. THERMODYNAMICS OF IONIZATION OF DEUTERIUM OXIDE. Goldberg, Robert Nathan. Pittsburgh, Carnegie-Mellon Univ., 1968. 153p.

Thesis.

Results of cryoscopic, calorimetric, and conductometric investigations of betaine and betaine hydrochloride in aqueous solution are presented and used in subsequent thermodynamic calculations. For ionization of aqueous $[(CH_3)_3N^+CH_2COOH]$ the following values were found: $\Delta G^0 = 2.50$ kcal mole^{-1}, $\Delta H^0 = -0.08$ kcal mole^{-1}, $\Delta S^0 = -8.7$ cal deg^{-1} mole^{-1}, and $\Delta C_p^0 \cong -7$ cal deg^{-1} mole^{-1}. A new freezing point apparatus utilizing thermistors is described. Heats of solution of $CoSO_4(c)$ and several hydrates were measured. From the results of these measurements the following calculations were made: $\Delta H_{298} = -2.48$ kcal mole^{-1} for $CoSO_4 \cdot 6H_2O(c) + H_2O(l) = CoSO_4 \cdot 7H_2O(c)$; $\Delta H_{298} = -12.8$ kcal mole^{-1} for $CoSO_4 \cdot H_2O + 5H_2O(l) = CoSO_4 \cdot 6H_2O(c)$ and $\Delta H_{298} = -6.1$ kcal mole^{-1} for $CoSO_4(c) + H_2O(l) = CoSO_4 \cdot H_2O(c)$. These results were also used in calculating $\Delta H_f^0 = -13.9$ kcal mole^{-1}, $\overline{S}_2^0 = -26.0$ cal deg^{-1} mole^{-1}, and $\Delta G_f^0 = -13.3$ kcal mole^{-1} for $Co^{2+}(aq)$. This free energy leads to $E^0 = 0.29$ V for the Co/Co^{2+} standard oxidation potential. Heats of formation as follows have been calculated for the mono-, hexa-, and heptahydrates of cobalt sulfate, respectively: $\Delta H_f^0 = -286.4$, -640.8, and -711.6 kcal mole^{-1}. A value of S_{298}^0 was calculated to be 42 cal deg^{-1} mole^{-1} for $CoSO_4 \cdot H_2O(c)$. Heat of solution measurements lead to $\Delta H_{298} = -15.1$ kcal mole^{-1} for $NiSO_4 \cdot H_2O(c) + 5H_2O(l) = NiSO_4 \cdot 6H_2O(c)$ and to ΔH_f^0 values of -283.9 and -640.6 kcal mole^{-1} for the mono- and hexahydrate. Existing thermochemical data for Ru, Os, Rh, Ir, Pd, and Pt and their compounds have been critically reviewed. "Best" values of ΔG_f^0, ΔH_f^0, and S_{298}^0 are tabulated together with relevant oxidation potentials. A brief summary of the descriptive chemistry of these elements and their compounds is given. Heats of neutralization of HCl (in H_2O) with NaOH (in H_2O) and of DCl (in D_2O) with NaOD (in D_2O) have been measured calorimetrically. Heats of dilution of NaOD (in D_2O) have also been measured. Results of these measurements have been combined with other heat

of dilution data to yield standard heats of ionization of H_2O and D_2O at 298°K. The results are ΔH^0 = 13,350 cal/mole for H_2O and ΔH^0 = 14,488 cal/mole for D_2O. This ΔH^0 for H_2O is in excellent agreement with results of several other calorimetric investigations, but is smaller than a value derived from the variation of the ionization constant of H_2O with temperature. The value of ΔH^0 determined calorimetrically for D_2O is larger than the value derived from variation of the ionization constant of D_2O with the temperature. Free energies and entropies of ionization of H_2O and D_2O are calculated and tabulated. Standard states and concentration scales for aqueous solutions are discussed. (Disser. Abstr.)

33191 HEPTAVALENT PLUTONIUM. Keller, C.; Seiffert, H. (Univ., Karlsruhe, Ger. Kernforschungszentrum, Karlsruhe, Ger.). Angew. Chem. Int. Ed. Engl., 8: 279-80(Apr. 1969).

The preparation of pure pentalithiumplutonium(VII) hexoxide, Li_5PuO_6, is described. The x-ray diffraction pattern of the greenish-black Li_5PuO_6 showed the lattice to be hexagonal with a = 5.19 ± 0.02 A and c = 14.48 ± 0.02 A [space group $R\bar{3}$ (?), $d_{x\text{-ray}}$ for $Li_5{}^{239}PuO_6$ = 3.53 g/cm³]. Li_5PuO_6 dissolves in water and in LiOH solutions to give a green coloration. Such solutions are not stable and are quantitatively converted into yellow solutions of Pu(VI) within 2 to 3 min, the rate of reaction being inversely proportional to the concentration of LiOH. (P.C.H.)

33192 PHOTOSENSITIZED ISOMERIZATIONS OF DIDEUTEROETHYLENES. Sato, Shin (Tokyo Inst. of Tech.). Pure Appl. Phys., 16: 87-92(1968).

From 2nd International Symposium on Photochemistry, Enschede, Netherlands. See CONF-670734.

The infrared spectrum of the product of benzene photosensitized reactions of trans-dideuteroethylene is shown. (M.C.G.)

33193 PLENARY LECTURES PRESENTED AT THE SECOND INTERNATIONAL SYMPOSIUM ON PHOTOCHEMISTRY, HELD AT ENSCHEDE, THE NETHERLANDS, 16-22 JULY, 1967. Pure Appl. Chem., 16: 1-200(1968). (In French and English). (CONF-670734).

Thirteen lectures are included and a separate abstract was prepared for one of them. (M.C.G.)

For an abstract of the individual paper see: 33192.

33194 ELECTRON-DIFFRACTION STUDY OF AMMONIA AND DEUTEROAMMONIA. Kuchitsu, Kozo (Tokyo Univ.); Guillory, J. P.; Bartell, L. S. J. Chem. Phys., 49: 2488-93 (Sept. 15, 1968). (IS-1938).

The gas-phase structures of NH_3 and ND_3 molecules were determined by the sector-microphotometer method of electron diffraction. The following internuclear distances r_g and mean amplitudes l_e with estimated standard errors were obtained: for NH_3, $r_g(N-H) = 1.030_2 \pm 0.002$ Å, $r_g(H-H) = 1.662 \pm 0.010$ Å, $l_e(N-H) = 0.073_1 \pm 0.002$ Å, $l_e(H-H) = 0.125 \pm 0.006$ Å, and for ND_3, $r_g(N-D) = 1.026_6 \pm 0.003$ Å, $r_g(D-D) = 1.654 \pm 0.008$ Å, $l_e(N-D) = 0.061_1 \pm 0.002$ Å, $l_e(D-D) = 0.101 \pm 0.006$ Å, with the parameter κ representing bond-stretching anharmonicity fixed at 1.0×10^{-5} and 0.5×10^{-5} Å³ for N-H and N-D, respectively. Effects of anharmonicity and isotope differences in the structural parameters analogous to those in CH_4 and CD_4 were observed. The r_α^0 and r_e bond distances calculated from the above r_g distances are found to be consistent with the corresponding r_z and r_e distances derived from the spectroscopic rotational constants of Benedict and Plyler. The isotope effects reported by Bell and by Halevi for the dipole moment and polarizability of ammonia are discussed briefly in the light of the present results. (auth)

33195 POLAROGRAPHY OF EUROPIUM(III) COMPLEX WITH D-GLUCOSAMINIC ACID. Masuda, Yoshitaka; Misumi, Seizo (Kyushu Univ., Fukuoka). Nippon Kagaku Zasshi, 90: 471-7(May 1969). (In Japanese).

By polarography of a europium(III) complex with D-glucosaminic acid, the electrode process, ionic species in the vicinity of the electrode surface and rate constant of the electrode reaction were determined. The complex ions such as $[EuG]^{2+}$, $[Eu(G)_2]^+$ and $[EuG(OH)]^+$ were found by potentiometric titrations. The formation constants of these complexes were calculated to be log K_1 = 5.24 and log K_1K_2 = 10.52 by Bjerrum method ($[Eu^{3+}]$: 1.002_7 mmole/liter, μ = 0.1 ($NaClO_4$)). A two-stepped wave was observed. Both the electrode reactions of the first and the second waves were diffusion controlled. The first wave was one electron reduction and irreversible. The second wave depended on the $[H^+]$ and attributed to the reduction of H^+ produced by hydrolysis of the reduced complex. The half-wave potential of the first wave was almost constant in the pH range from 10.15 to 10.80. The electrode reactions at pH = 10.5 (μ = 0.1 ($NaClO_4$)) are given as: $[Eu\ G_2]^+ \rightleftharpoons [EuG]^{2+} + G^-$ and $[EuG]^{2+} + e \rightarrow [EuG]^+$. The rate constants of the electrode reaction were determined to be 2.05×10^{-15} cm/sec for $[Eu^{3+}]:[G^0] = 1:5$ and 3.24×10^{-17} cm/sec for $[Eu^{3+}]:[G^0] = 1:40$, respectively. On each side of cathodic and anodic dV/dt = f(V) curve, one cut-in was observed at pH = 10.5. As the result of NMR measurement, some interactions between oxygen of polyalcohol OH group of D-glucosaminic acid and metal ion were observed. (NSA of Japan)

33196 ISOTOPE EFFECTS OF TRITIUM IN THE HYDRATION PROCESS OF HEPTAHYDRATED NICKEL SULFATE. Tanaka, Haruhiko; Negita, Hisao (Hiroshima Univ.). J. Sci. Hiroshima Univ., Ser. A-II, 32: 299-302(Dec. 1968).

Investigations were made on effects of tritium in the hydration of heptahydrated nickel sulfate, $NiSO_4 \cdot 7H_2O$. It was observed that tritium in the water of crystallization is considerably diluted in comparison with that of the mother liquid. The results were discussed quantitatively from the crystal growth theory. No appreciable isotopic separation occurred in the process of the stepwise dehydration. (NSA of Japan)

33197 SECONDARY DEUTERIUM ISOTOPE EFFECTS. I. THEORETICAL CALCULATIONS. II. THE BENZYL SYSTEM. Rapp, Michael Warren. Bloomington, Ind., Indiana Univ., 1968. 143p.

Thesis.

An unsatisfactory model for the β-deuterium effect on the ionization of t-butyl chloride was replaced by a more rigorous model. The only significant force constant change involving the isotope in the former model was in the C-H stretch, while the latter model included bending force constant changes. In the more rigorous model, a conformational inequality of the methyl hydrogens was required to account for the experimentally observed noncumulative character of the isotope effect. Experimental determination of the isotopic fractionation factor for vaporization of t-butyl and t-butyl-d_9 chloride indicated that the origin of the kinetic effect was not due to a ground state free energy difference. Disproportionation equilibrium isotope effects have been calculated according to present theory and agree with available experimental data. The results obtained from model calculations of equilibrium systems with large noncumulative effects indicated the necessity for a significant change in a bending force constant as the isotope progressed from reactant to product. The α-deuterium effect for the benzyl system was shown to be very sensitive to changes in mechanism. Benzyl-α-d_2 brosylate exhibited an effect per D at 25° of from 5.3% in 95 vol % ethanol-water to 17.3% in 97 wt % trifluoroethanol-water. That this was a mechanistic effect was borne out by the observation that p-nitrobenzyl-α-d_2 brosylate, a compound which should be less susceptible to unimolecular or limiting reaction, exhibited an isotope effect per D at 25° of 1.002 to 1.006 in ethanol-water mixtures varying from 10 to 30% water. This low and fairly constant value provides the nucleophilic extreme to the mechanistic range of effects, the limiting extreme of which had already been supplied by the α-phenylethyl chloride system. Product studies of benzyl brosylate in various ethanol-water and trifluoroethanol-water solvents showed that ethanol was a better nucleophile than water (1.7:1.0 over a range of solvents), but that water was 2 to 5 times as good a nucleophile as trifluoroethanol. These results are related to other product distributions and their mechanistic consequences discussed. (Disser. Abstr.)

33198 TECHNETIUM(VII) OXIDE: A TRANSITION METAL OXIDE WITH A MOLECULAR STRUCTURE IN THE SOLID STATE. Krebs, B. (Univ., Goettingen, Ger.). Angew. Chem. Int. Ed. Engl., 8: 381-2(May 1969).

It is shown that the structure of crystalline Tc_2O_7 consists of an arrangement of isolated Tc_2O_7 molecules with tetrahedral coordination of the technetium. The configuration about the central O atom in Tc_2O_7 is exactly linear as a result of the C_i symmetry of the molecule. (M.C.G.)

33199 STUDIES ON MONODENTATE COMPLEXES OF TITANYL, ZIRCONYL, AND THORIUM PERCHLORATES. Krishnan, V. Bangalore, India, Indian Institute of Science, 1966.

Thesis.

Titanyl perchlorate hexahydrate, $TiO(ClO_4)_2 \cdot 6H_2O$, has been prepared, and its physicochemical properties, such as cryoscopic determination of molecular weight, conductivity in aqueous solution, cation exchange, and thermal properties have been investigated. The crystalline compound was found to belong to the orthorhombic system by the x-ray powder diffraction method. An attempt has been made to prepare peroxy titanyl perchlorate. The electronic absorption spectrum of this compound in aqueous solution gave

two bands and they were ascribed to electron transfer and electron excitation. The dissociation constant of the peroxy group in peroxy titanyl perchlorate has been determined by the molar ratio method. A new volumetric method for the estimation of perchlorate has been developed based on its reduction by ferrous sulfate in the medium of strong sulfuric acid. Pyridine N-oxide complex of titanyl perchlorate, $TiO \cdot 5C_5H_5NO \cdot -(ClO_4)_2$ has been prepared and its physico-chemical properties compared with those of zirconyl and thorium complexes. Quinoline N-oxide complexes of titanyl, $TiO \cdot 5C_9H_7NO \cdot (ClO_4)_2$, zirconyl, $ZrO \cdot 6C_9H_7NO \cdot -(ClO_4)_2$, and thorium, $Th \cdot 6C_9H_7NO \cdot (ClO_4)_4$ have been prepared, their physicochemical properties studied, and structures assigned. Quinoline N-oxide adduct of perchloric acid has also been prepared and structure assigned on the basis of its properties. Triphenyl phosphine oxide (TPO) complexes of titanyl, $TiO \cdot 4TPO - (ClO_4)_2$, zirconyl, $ZrO \cdot 6TPO(ClO_4)_2$ and thorium, $Th \cdot 8TPO(ClO_4)_4$ have been prepared, their physicochemical properties investigated and structures assigned. The infrared spectra of these molecules showed that the TPO molecules are bonded to the metal ions through oxygen of the PO group. The dimethyl sulfoxide (DMSO) complexes of titanyl, $TiO \cdot 5DMSO - (ClO_4)_2$, zirconyl, $ZrO \cdot 8DMSO(ClO_4)_2$, thorium, $Th \cdot 12DMSO(ClO_4)_4$ and uranyl, $UO_2 \cdot 5DMSO(ClO_4)_2$ have been prepared. The differential thermal analysis of the complexes showed that the latter three complexes lost, respectively, 2, 6, and 1 molecule of lattice held DMSO, around 180°C. The infrared spectra showed that the coordinated DMSO was bonded to the metal ions through oxygen of SO in the parent complexes and through sulfur in the complexes heated around 180°C. X-ray powder diffraction studies showed that the zirconyl and thorium complexes belong to the hexagonal crystal system. The complexes were assigned the structures. A comparison of the bonding of the monodentate complexes of titanyl, zirconyl, and thorium perchlorates with pyridine N-oxide, quinoline N-oxide, triphenylphosphine oxide, and dimethyl sulfoxide has also been attempted. (Indian Sci. Abstr.)

33200 CALCULATION OF THE ISOTOPE EFFECT ON THE TRIPLET LIFETIME OF PARTIALLY DEUTERATED NAPHTHALENES. Henry, B. R.; Siebrand, W. (National Research Council of Canada, Ottawa). Chem. Phys. Lett., 3: 327-8(May 1969).

Differences in triplet lifetime between α- and β-deuterated naphthalenes are calculated in good agreement with experiment. The calculation is based on vibronic spin-orbit coupling involving $\sigma\pi^*$ and $\pi\sigma^*$ states together with CH out-of-plane bending modes. (auth)

33201 SOME PROPERTIES OF HEXAVALENT URANIUM IN ALKALINE MEDIUM. Musikas, C. (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Radiochem. Radioanal. Lett., 1: 133-6(June 1969). (In French).

Uranyl peroxide solutions were oxidized chemically and electrolytically in an alkaline medium. When oxidation is carried out in NaOH solutions of concentrations of less than 5M the orange color of the uranyl peroxide disappears. This phenomenon can be attributed to the destruction of the peroxide compound. At a higher sodium hydroxide concentration, the oxidation gives rise to a purple colored solution. (auth)

33202 SPECTROSCOPIC BEHAVIOR OF THE URANIUM(V) ION IN TERNARY OXIDES. Kemmler-Sack, S. (Univ., Tuebingen, Ger.). Z. Anorg. Allg. Chem., 363: 295-304(Dec. 1968). (In German).

The reflectance spectra of some ternary uranium(V) oxides were measured from 4000 to 40,000 cm^{-1}. The optical properties are strongly influenced by the symmetry of the ligand field. The spectra of KUO_3, $RbUO_3$, $KSrU_2O_6F$, $RbSrU_2O_6F$, $KBaU_2O_6F$, and $RbBaU_2O_6F$ were analyzed on the basis of the 5 f^1 configuration for the U(V) ion in an octahedral ligand field. Eighteen references are cited. (JPRS)

33203 STUDIES OF SOME OCTATHIOCYANATE COMPLEXES OF THORIUM(IV) AND URANIUM(IV). I. INFRARED SPECTRA IN THE ν(CN) REGION. Grey, I. E.; Smith, P. W. (Univ. of Tasmania, Hobart, Australia). Aust. J. Chem., 22: 311-15(Feb. 1969).

Infrared spectra were recorded for compounds of formula $A_4(I)M(IV)(NCS)_8 \times H_2O$ (M = Th, U; A = Cs, Rb, NH_4) in the region 2200 to 265 cm^{-1}. For each of the complexes studied only 2 bands were found, viz., a weak peak at 2088 ± 2 cm^{-1} and a strong peak at 2050 cm^{-1}, with half-widths estimated as 10 and 40 cm^{-1}, respectively. The intensity of the band at 2085 cm^{-1} decreased with respect to the weaker band with decreasing concentration until in sufficiently dilute solutions the 2 bands were of comparable intensity. By contrast, in the solid state the Cs and Rb salts exhibited 4 well-defined band splittings in the ν(CN) region. The band positions are closely similar for 3 of the salts studied and cover a range of less than 40 cm^{-1}, although small differences in relative intensities were observed. For $Cs_4U(NCS)_8 \cdot H_2O$ a wider splitting of 86 cm^{-1} was found. However, in the case of $(NH_4)_4[U(NCS)_8]$ only one broad band with a high frequency shoulder was observed. The band-width was not greater than that for the other salts and the apparent discrepancy may be connected with the difficulty of preparing a mull with this extremely hygroscopic compound. For the solid complexes, other absorption band maxima observed in the range 2200 to 265 cm^{-1} are listed, together with assignments. All observed bands could be assigned to ν(CN), ν(CS), δ(NCS), or δ(HOH). The results suggest that both the $[Th(NCS)_8]^{4-}$ and $[U(NCS)_8]^{4-}$ complexes adopt the configuration of an Archimedean antiprism in solution, but in the solid state the symmetry is lowered to dodecahedral. (BBB)

33204 ADDITION COMPOUNDS OF $HfCl_4$ AND $ZrCl_4$ WITH ORGANIC LIGANDS. Graven, W. M.; Peterson, R. V. (Aerospace Corp., El Segundo, Calif.). J. Inorg. Nucl. Chem., 31: 1743-8(June 1969).

Additional compounds of $HfCl_4$ and $ZrCl_4$ with eight organic ligands were prepared and analyzed. Infrared spectra and thermal decomposition measurements demonstrated the similarity of properties between addition compounds of these two metal tetrahalides. The organic ligands used were: dimethylformamide, pyridine, acetonitrile, methyl formate, acetone, dimethyl ether, diethyl ether, and dioxane. Although some differences between the spectra of the $HfCl_4$ addition compounds and their $ZrCl_4$ analogs were observed, no systematic variation was apparent. (P.C.H.)

Radiation and Nuclear Chemistry

Refer also to abstracts 33624 and 34057.

33205 (COO-38-661) BIBLIOGRAPHY ON THE RADIATION CHEMISTRY OF ALKANES. Potvin, Eve-Marie; Ross, Alberta B. (Notre Dame Univ., Ind. Radiation Lab.). May 1969. 68p. Dep. CFSTI.

Literature on the radiation chemistry of alkanes is covered by this bibliography. Investigations of aqueous solutions of alkanes are not included. The papers are listed by serial number that is approximately chronological under the following categories: gas phase, liquid phase, solid phase, heterogeneous systems, radiation synthesis, oxidation, and books and reviews. An author index and compound index are included. (M.C.G.)

33206 (COO-1728-2) CHEMICAL CONSEQUENCES OF THE AUGER EFFECT IN THYROXINE AND ITS ANALOGUES. Progress Report, May 1, 1969. Diehn, Bodo (Toledo Univ., Ohio. Dept. of Chemistry). May 31, 1969. Contract AT(11-1)-1728. 17p. Dep. CFSTI.

Absorption of x radiation in iodothyronines results mainly in deiodination. G-values and dose effect curves were determined from 0.5 to 3.0 Mrads total dose for 3,5-diiodo-DL-thyronine, 3,5,3'-triiodo-DL-thyronine, and thyroxine. I_2 yield measurements as a function of maximum x-ray energy indicate, after correction for radiation dose, that there is a distinct effect of resonance absorption on the ensuing chemical transformation. The Auger chemistry of iodobenzene is being investigated. (M.C.G.)

33207 (UCLA-12-728) OPTICAL SPECTRA AND REACTIVITY OF ORGANIC FREE RADICALS FORMED BY REACTION OF HYDROXYL FREE RADICAL WITH PYRIMIDINE BASES: A PULSE RADIOLYSIS STUDY. Myers, L. S. Jr.; Hollis, Mary Lynn; Theard, L. M.; Peterson, F. C. (California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology). [1966]. Contract AT-04-1-GEN-12. 36p. Dep. CFSTI.

Dilute aqueous N_2O-saturated solutions of uracil, thymine, cytosine, and 5-methylcytosine were irradiated with sub-microsecond pulses of 10-MeV electrons, and changes in optical absorbence in the wavelength range 300 to 600 nm were monitored for periods up to 1700 μsec. Spectra of radicals formed by addition of OH· to pyrimidine bases (pH 7) are shifted far towards the red as compared with the parent compounds, and have broader absorption bands. The red shift is greater with 4-amino than with 4-oxo compounds. The principal path for radical reaction is by a second order decay process with $2k = 2 \times 10^9$ M^{-1} sec^{-1}, but growth of a long-lived product results in complex decay kinetics at some wavelengths. At higher pHs (reactants and product radicals at least partially in anionic form) the spectra are shifted further towards the red than at pH 7, and decay kinetics are more complex. At pH 11.4 some of the spectra undergo extremely rapid changes in shape ($t_{\frac{1}{2}} < 1$ μsec with cytosine) which are attributed to reaction of the initial radicals with OH^- ion. At pH 12.5 relatively large amounts of long-lived absorbing products

are formed, and 5-methyl compounds give a spectrum which differs from that observed at pH 11.4 or with 5-hydro compounds at either pH. This spectrum is attributed to RCH_2^- radicals. Tentative reaction schemes including radical formation, adjustment of the ionic state of the radicals to the pH of the medium, and radical decay are suggested. (auth)

33208 CHARACTERIZATION OF TRAPPED ELECTRONS IN γ-IRRADIATED HYDROCARBON POLYMERS BY ELECTRON SPIN RESONANCE AND OPTICAL ABSORPTION SPECTROSCOPY. Keyser, Ronald M. (Oak Ridge National Lab., Tenn.); Williams, Ffrancon. Contract AT(40-1)-2968. J. Phys. Chem., 73: 1623-4(May 1969). (ORO-2968-44).

Evidence is presented from both ESR and optical measurements which indicates that the nature of the trapping sites in hydrocarbon polymers is different from that in either glassy or crystalline alkanes. For irradiated polyethylene (linear and branched) and the isotactic forms of polypropylene and poly (4-methylpentene-1), the ESR spectrum consisted of a narrow singlet superimposed on a broad free radical spectrum. The spectroscopic splitting factor for linear polyethylene was found to be $g = 2.0022 \pm 0.0002$. These factors indicate that the ESR singlet in these materials is due to trapped electrons. Results suggest electron trapping in a void that is larger than in alkane glasses. (D.H.M.)

33209 RADIATION-INDUCED ISOMERIZATION OF CYCLOHEXANE ON SILICA–ALUMINA. Hentz, Robert R.; Wickenden, Dennis K. (Univ. of Notre Dame, Ind.). J. Phys. Chem., 73: 1608-10(May 1969). (COO-38-632).

A study was made to determine whether γ-irradiated silica–alumina causes the acid-catalyzed isomerization of cyclohexane to methylcyclopentane (MCP). Irradiation of cyclohexane adsorbed on silica–alumina gives MCP and H_2 as the only measurable products at F (the number of cyclohexane electrons in the system divided by the total number of electrons) of less than ~0.2. Addition of cyclohexane to irradiated silica–alumina gave MCP as the only measurable liquid product and little or no gas noncondensable at −196°C ($<10^{16}$ molecules/g of solid). After product recovery, addition of fresh cyclohexane to the same solid gave no additional MCP or any other product. Thus, a catalytic reaction on radio-induced sites is not involved. The evidence indicates that certain adsorbates (such as cyclohexane, isopropylbenzene, and isobutene) can interact with migrating and trapped positive holes produced in silica and silica–alumina gels by irradiation in such a way as to give reactions characteristic of acid sites and their carbonium–ion progeny. (D.H.M.)

33210 PHASE EFFECTS ON RECOIL TRITIUM REACTIONS WITH BENZENE. Schroeder, John W.; Monroe, Nodie Mae; Garland, John K. (Univ. of Missouri, Columbia). J. Phys. Chem., 73: 1252-6(May 1969).

The reactions of recoil tritium with gaseous, liquid, and solid benzene were studied. Major products were HT, cyclohexene-t, 1,3- and 1,4-cyclohexadiene-t, benzene-t, and higher molecular weight "polymers" of varying volatility. A reaction model is proposed including three general classes of reactions: true hot atom reactions, hot radical reactions, and thermal radical reactions. The hot radical reactions of the cyclohexadienyl-t intermediates include decomposition in gas phase, chain-transfer reactions (including both H transfer to benzene and the endothermic abstraction of H from benzene) in liquid phase and in liquid drops formed in solid-phase samples, and chain polymerization in liquid and liquid drops. Thermal reactions include chain polymerization to relatively long chains in gas samples, where the reaction may involve wall effects. In the liquid phase, thermal chain polymerization is more extensive but gives lower average chain lengths. In solid-phase samples chain transfer to neighbors or reaction with diffusing H atoms is proposed. The ratio of 1,4-cyclohexadiene-t to 1,3-cyclohexadiene-t is 1.4 : 1 in the liquid phase and 2.1 : 1 in the solid phase where more thermal reaction (reported to give a 2.7 : 1 ratio) contributes to cyclohexadienes and benzene as chain polymerization is reduced. Cyclohexene-t is attributed to radiation damage effects on the cyclohexadiene-t. (auth)

33211 MODEL FOR THE RADIOLYSIS OF WATER. Hamill, William H. (Univ. of Notre Dame, Ind.). J. Phys. Chem., 73: 1341-7(May 1969). (COO-38-618).

A model for the radiolysis of water at low LET is based on primordial, isolated single $H_3O^+ - e^-$ pairs. It considers effects arising from hole and electron migration, reaction, and recombination prior to hydration. The high-frequency dielectric constant applies, and the early phenomena (which are generally ignored) should resemble their analogs in low-dielectric media, e.g., cyclohexane, which provide appropriate criteria. Dielectric relaxation follows charge trapping both inside and outside the escape distance (~10 Å), only the latter giving observable e^-_{aq}. It is also assumed that e^- prior to hydration is unreactive with H^+_{aq}. Effects usually attributed to spurs are assigned to geminate (H, H, OH, OH) arising from energetic recombination of non-hydrated (H_3O^+, OH, e^-). These and other consequences of the model are compared with the recent literature on the radiolysis of aqueous systems. (auth)

33212 RADIOLYSIS OF METHANOL AND METHANOLIC SOLUTIONS. V. THE ACID EFFECT. Suryanarayanan, K.; Lichtin, Norman N. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-1)-2383. J. Phys. Chem., 73: 1384-91(May 1969).

Extensive measurements of the effect of acid on yields of products from the ^{60}Co γ radiolysis of liquid methanol confirm previously reported enhancement of radiolytic yields. Product enhancement is discernible with approximately 10^{-5} M acid and is fully developed with 10^{-3} M acid: $\Delta G(H_2) = 0.9$; $\Delta G(CH_4) = 0.0$; $\Delta G(CH_2O) = 0.3$; $\Delta G(HOCH_2CH_2OH) = 0.7$. Measurements of $G(H_2)$ as a function of solute concentrations in the presence of 3.76×10^{-2} M acid plus varying (O_2), varying (O_2) in neutral solution, and varying (acid) plus 10^{-3} M (O_2) provide the basis for evaluation of the rate ratios $k_{H+O_2}/k_{H+CH_3OH} = 5.8 \pm 0.7 \times 10^3$ and "$k_{e^-_{aq}+O_2}/k_{e^-_{aq}+H^+}$" $= 0.36 \pm 0.11$ and of the yields (molecules/100 eV) $G_{H_2} = 1.81 \pm 0.27$, $G_H = 2.02 \pm 0.18$, $G_H + G_{e^-_s} = 3.96 \pm 0.27$, and $G_{e^-_s} = 1.45 \pm 0.30$. Repeated pulsing with 1.9-MeV electrons up to a total dose of 10^{20} eV ml^{-1} has no significant effect on the lifetime of the solvated electron nor does preirradiation with a dose of 1.5×10^{19} eV of ^{60}Co γ rays followed by rectification: $k_{decay} = 2.3 \times 10^5$ sec^{-1}. Possible explanations of the enhancement of yields by acid which are examined include competition of acid for the freely diffusing solvated electron with adventitious solutes or radiolytic products and interception by acid of various transient radiolytic species other than the solvated electron. (auth)

33213 REACTIONS OF RECOIL TRITIUM WITH PROPENE IN THE LIQUID PHASE. Mahan, Kent I.; Garland, J. K. (Univ. of Missouri, Columbia). J. Phys. Chem., 73: 1247-51(May 1969).

The yield of products from the reactions of recoil tritium from the $^6Li(n,\alpha)T$ nuclear reaction in pure liquid propene were obtained at temperatures of 25 and −98°C and compared to data from the gas phase. The yields of products were found to be similar in the gas and liquid phases. However, the yield of ethene-t was reduced in the liquid phase from the collisional stabilization of its excited precursor, n-propyl radical. The amount of propene-t from direct substitution and from radical decomposition was estimated from bond strength correlations and these estimates indicated that in both gas and liquid phases about 35% of the propene-t formed in the system came from direct substitution and 65% from H atom loss from propyl radicals. A change in mechanism is proposed from a unimolecular decomposition in the gas phase to a bimolecular hydrogen donation reaction for the same excited radical intermediates in the liquid phase. From the high yield of n-hexane relative to other dimers and the temperature effect on the distribution of the dimer and polymer yields, it is suggested that a sizable percentage of the dimer in liquid phase must be formed by "hot" radical addition to propene followed by termination of the hexyl radicals. (auth)

33214 USE OF SULFUR HEXAFLUORIDE TO DETERMINE $G(e^-_{D_2O})$ AND RELATIVE REACTION RATE CONSTANTS IN D_2O. Asmus, K.-D.; Fendler, J. H. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem., 73: 1583-4(May 1969).

Since SF_6 is a specific electron scavenger in water ($k_{e^-_{H_2O}+SF_6} = 1.65 \times 10$ M^{-1} sec^{-1} producing high yields of easily detectable fluoride ions, the system was used for determining unequivocally the yield of hydrated electrons in D_2O and for obtaining relative rate constants for reactions of $e^-_{D_2O}$ with SF_6 and other solutes from competitive studies. The fluoride ion yield in a buffered (10^{-3} M K_2HPO_4) neutral solution was found to be $G(F^-) = 18.4 \pm 0.3$ from the slope of a linear yield dose plot, extending from 0.1% to more than 10% conversion of SF_6. In H_2O solutions the relationship $G(F^-)/G(e^-_{aq}) = 6$ was established; therefore, the yield of hydrated electron in D_2O, $G(e^-_{D_2O})$, is equal to 3.06 ± 0.05. This value confirms the significant difference in the yield of hydrated electrons between D_2O and H_2O, the latter being 2.76 ± 0.05. The rate constants for the reaction of SF_6 with electrons in D_2O, was calculated to be $\sim 2.6 \times 10^{10}$ M^{-1} sec^{-1}. (D.H.M.)

33215 ESR STUDY OF FREE RADICAL TRANSFORMATION IN GAMMA-IRRADIATED STARCH. Adamic, K. (Inst. Ruder Boskovic, Zagreb). Staerke, 20: 3-5(1968).

Electron spin resonance (ESR) investigations of starch irradiated with ^{60}Co gamma rays at liquid nitrogen temperature indicate free radical transformation in a temperature interval from −145°C up to room temperature. In ESR spectra the transition of

low temperature triplet to room temperature doublet corresponds to the transformation. Since this is uneffected by conformation of pyranose ring, the transformation could be explained by the migration of radiation damage from C(6) to C(5). (auth)

33216 RADIATION CROSS LINKING OF UNSATURATED OLIGO ESTERS OF URETHANES WITH STYRENE. Omel'chenko, S. I.; Matyushova, V. G.; P'yankov, G. N. Vysokomol. Soedin., Ser. B, 11: 293-6(Apr. 1969). (In Russian).

Under the action of gamma radiation, the copolymerization of unsaturated oligo esters of urethanes with styrene occurs. In the process of radiation crosslinking the double bonds of the α,β-unsaturated dicarboxylic acid and monomer and the isocyanate groups participate. Physical-mechanical properties of the radiation-solidified copolymers depend on the structure of the components and on the concentration of the polar isocyanate groups. (M.C.G.)

33217 IONIZING RADIATION EFFECT ON NICKEL OXIDE AND ELECTRON THEORY OF CATALYSIS. Gisquet, Eric; Destriau, Michel (Faculte des Sciences, Bordeaux). Bull. Soc. Chim. Fr., No. 5, 1455-8(May 1969). (In French).

The influence of x rays and γ irradiations on chemisorption of oxygen on various nickel oxides was studied. From these measurements, it is shown that the quantity of chemisorbed oxygen is related to the position of the Fermi level of the solid before irradiation and to the nature of the radiation. These results are in good agreement with Wolkenstein's electron theory. It was observed, also, that the quantity increases with the time of irradiation and that, when irradiation is stopped, the material does not return rapidly to its initial state. (It was, therefore, possible to follow kinetics of annealing the failures.) Both these points are not in agreement with theory. (auth)

33218 STUDY OF HOT ATOM EFFECTS OF CADMIUM PHTHALOCYANINE USING A DAUGHTER-TRACING TECHNIQUE. Yoshihara, K.; Kudo, H. (Japan Atomic Energy Research Inst., Tokai). Nature (London), 222: 1060-1(June 14, 1969).

It is stated that difficulties in the chemical treatment of this complex have led to neglect of studies of associated Szilard–Chalmers processes; the complex is very insoluble and easily demetalled by H_2SO_4. It was considered important, however, to compare the behavior of recoil atoms in the Cd complex, in which the central atom has ionic character, with that in other complexes where the central atoms have covalent character. In the technique employed use was made of the fact that the bahavior of a recoil ^{115}Cd atom can be traced by the behavior of its daughter ^{115m}In. Experimental details are given and data for retentions and annealing effects are tabulated. It was shown that chemically combined ^{115}Cd was transformed to the ^{115m}In coupled after neutron irradiation (n,γ recoil event). On the other hand, the free ^{115}Cd ion liberated from the complex was transformed to the free ^{115m}In ion. The technique possessed the advantages of controlled dissolution temperature (H_2SO_4) and shortened chemical separation time. The data were quite reproducible. Comparisons are made with the dimethyl sulphoxide (DMSO) dissolution method. (UK)

33219 TEORIYA I METODY RADIATSIONNOI KHIMII VODY. (Theory and Methods of the Radiation Chemistry of Water). Shubin, V. N.; Kabakchi, S. A. Moscow, Izdatel'stvo Nauka, 1969. 216p.

Physical bases and the mathematical apparatus of different theoretical and semi-empirical models of the solvated electron are presented. Results evaluated on the basis of estimates of energy and steric characteristics are compared with data obtained by means of experimental investigations. Kinetic methods for radiochemical investigations are considered. (194 references). (tr-auth)

33220 AN EPR INVESTIGATION OF POLYMER FRACTURE. Roylance, David Kaye. Salt Lake City, Univ. of Utah, 1968. 218p.

Thesis.

Using EPR techniques bond breakage induced by γ-irradiation and grinding as well as uniaxial tension was studied for a number of polymers. It was possible to determine how many of which bonds are broken during fracture and to monitor the bond breakage as a function of time so as to provide important new insights into the mechanism and kinetics of the fracture process. Highly crystalline, oriented fibers proved most amenable to EPR analysis during tensile fracture and tensile data taken on drawn polycraprolactam (Nylon 6) and polyethylene fibers are presented. From an analysis of the EPR spectra and correlation with other results in the literature, it was deduced that the primary fracture points in Nylon 6 are the c–c bonds occupying β-positions with respect to the amide groups. Free radical concentrations in this material reach approximately 10^{17} spins/g at fracture and follow kinetics that seem to imply that presently existing theories of bond rupture are oversimplified. Although the kinetics of free radical formation are complex, a correlation between stress and the steady-state free radical concentration was found that took the form of a thermally-activated stress-aided process. (Disser. Abstr.)

33221 RADIATION CHEMISTRY OF THE α-AMINO ACIDS. γ RADIOLYSIS OF SOLID CYSTEINE. Peterson, Donald B.; Holian, John; Garrison, Warren M. (Univ. of California, Berkeley). J. Phys. Chem., 73: 1568-72(May 1969).

The γ radiolysis of solid cysteine is shown to yield hydrogen, hydrogen sulfide, ammonia, and cystine as major products. Radiolysis data are also given for a series of related compounds: cystamine, N-acetylcysteine, S-methylcysteine, glycine, and alanine. The proposed reaction schemes provide a basis for correlating the radiation chemistry of these solid-state systems. (auth)

33222 PREPARATION OF HEAT-RESISTANT POLYETHERS. Fukui, Kenichi (to Sumitomo Chemical Co.). Japanese Patent 1968-28117. Dec. 3, 1968. Filed Jan. 10, 1964.

Heat-resistant formaldehyde polymers were prepared by x or γ irradiation of mixture of formaldehyde, anhydride, salt of a metal of the 1st or 2nd group in the periodic table and a carboxylic acid, and CO_2. Amounts of other constituents, relative to formaldehyde for the polymerization traces are 10 to nearly 100% carboxylic anhydride, 0.001 to 1 wt % salt, 0.1 to 80 wt % CO_2. Details of the polymerization method are described for the system consisting of acetic anhydride, sodium acetate, and ether. (TSS)

33223 DEVICE FOR GRAFT POLYMERIZATION. Tada, Syotaro (to Sumitomo Electric Industries, Ltd). Japanese Patent 1969-1278. Jan. 18, 1969. Filed Jan. 11, 1965.

A device is proposed for effective and economical graft polymerization by attaching a compound onto a film or sheet and then irradiating the combination. Strips of film are supported on the outside surface of a rotating drum, in the direction of the drum axis, at regular intervals. If the film is a long piece, it can be run through the drum and a separate pulley. A vessel filled with the liquid compound is installed in an appropropriate position, with respect to the rotating drum so that the film on the drum passes through the liquid. A means for irradiating the film after painting is installed in another position. (NSA of Japan)

33224 RATE CONSTANT FOR SCAVENGING OF ELECTRONS PRODUCED IN THE RADIOLYSIS OF HYDROCARBONS AND THE TIME SCALE FOR THE ION-RECOMBINATION PROCESSES. Rzad, Stefan J.; Infelta, Pierre P.; Warman, John M.; Schuler, Robert H. (Carnegie-Mellon Univ., Pittsburgh). J. Chem. Phys., 50: 5034-5(June 1, 1969).

A method to obtain an estimate of the rate constant for the electron scavenging process (k_s) by a comparison of the description of the concentration dependence of scavenging with the observations of Thomas and co-workers on the time dependence of the negative-ion concentration following the nanosecond pulse irradiation of a cyclohexane solution of biphenyl. The yield of biphenylide negative ion remaining 100 nsec after a 10-nsec pulse was measured to be 0.3 in a solution of 0.1M biphenyl in cyclohexane. Subtracting a free-ion contribution of 0.1 from this yield the negative ion concentation is ~0.05. A rate constant of 3×10^{11} M^{-1} sec^{-1} was obtained for the reaction of electrons with the biphenyl. This value describes the biphenylide-ion decay quite exactly from 10 to 1000 nsec. It was concluded that in cyclohexane 50% of the electrons decay in 30×10^{-12} sec but that 4% (a G of 0.16) still remain at 10^{-8} sec. (D.H.M.)

33225 STUDIES OF ELECTRET CHARGES PRODUCED ON POLYMER FILMS BY ELECTRON BOMBARDMENT. Sessler, G. M.; West, J. E. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Polym. Sci., Part B, 7: 367-70(May 1969).

Electron bombardment was used for the production of electrets on thin polymer films. The procedure makes use of secondary emission from both the material to be charged and an adjacent dielectric surface and backscattering from the adjacent surface. Measurements of net charge on fluorocarbon electrets as a function of time at room temperature showed an initial drop and then a buildup of charge. Preliminary studies indicate that at rising temperatures the charges on fluorocarbon monocharge electrets formed with electron bombardment are more temperature resistant than those on thermoelectrets. (J.G.B.)

33226 DOSE RATE DEPENDENCE IN THE RADIATION-INDUCED POLYMERIZATION OF NITROETHYLENE. Yamaoka, Hitoshi; Mori, Hiroaki; Hayashi, Koichiro; Okamura, Seizo (Kyoto Univ.). J. Polym. Sci., Part B, 7: 371-3(May 1969).

The γ-radioinduced polymerization of exhaustively dried nitroethylene in bulk was studied as a function of dose rate. It is concluded that the polymerization proceeds by free anionic propagation and terminates by charge neutralization between the propagating anion and the positive recharged species. (J.G.B.)

33227 SOLID STATE POLYMERIZATION AT LIQUID HELIUM TEMPERATURE. Ishigure, Kenkichi; Tabata, Yoneho; Oshima, Keichi (Tokyo Univ.). J. Polym. Sci., Part B, 7: 375-8(May 1969).

The γ-radioinduced polymerizations of several monomers are compared at 4.2 and 77°K. Crystalline isobutene, acetylene, and methacrylonitrile and glassy acrylonitrile produced no polymers at 4.2°K. Yields from the polymerization of crystalline acrylonitrile and glassy propylene oxide at 4.2 and 77°K and at various doses are tabulated. The rate of polymerization decreased greatly at 4.2°K. (J.G.B.)

33228 SPECTROSCOPIC STUDIES ON RADICALS PRODUCED FROM ACRIDINE AND ACRIDAN IN γ-IRRADIATED RIGID SOLUTIONS AT −196°C. Shida, Tadamasa; Kira, Akira (Inst. of Physical and Chemical Research, Saitama, Japan). Bull. Chem. Soc. Jap., 42: 1197-1201(May 1969).

Dilute solutions of acridine in ethers and amines were frozen at −196°C to a glassy solid and were γ-irradiated. Electrons ejected by ionization are effectively scavenged by acridine to produce acridine anions which are the sole species having an electronic absorption band in the visible region. In alcohol and ester matrices the anion abstracts a proton from the matrix molecule even at −196°C and yields a semiquinone radical equivalent to the species formed by H-atom abstraction at the 9-position of acridan (dihydroacridine). Acridan in γ-irradiated butyl chloride matrix forms acridan cation which has a characteristic absorption band at 500 to 750 mμ. Detachment of a proton from the acridan cation produces another semiquinone radical identifiable with the species formed by H-atom abstraction at the 10-position of acridan. Both radicals have a similar yet clearly distinguishable absorption band in the visible region. (auth)

33229 NATURE OF PARAMAGNETIC CENTERS AND THE MECHANISM OF THEIR PHOTOCONVERSIONS IN γ-IRRADIATED GLYCINE MONOCRYSTALS. Pasoyan, V. G.; Kayushin, L. P.; Pulatova, M. K. (Inst. of Agrochemical Problems and Hydroponics, Erevan. Inst. of Biological Physics, Pushchinoon-Oka, USSR). Biophysics (USSR) (Engl. Transl.), 13: 716-24(1968).

Translated from Biofizika, 13: 600-7(1968).

On γ irradiation of glycine at 77°K for all the orientations of the monocrystal relative to the direction of the external magnetic field, the doublet form of the EPR signal with a 1:1 ratio of intensity of the components and a value of doublet splitting changing with orientation from 20 to 25 Oe was observed. On exposure to visible light (400 to 500 mμ) the paramagnetic centers with the doublet EPR signal disappeared. It was established that paramagnetic centers of this type are not stable with increase in temperature from 77°K. The following mechanism of photochemical conversion of the paramagnetic centers in γ-irradiated glycine monocrystals is proposed. Exposure of ($NH_3^+CH_2COO^-$) to light causes rupture of the C−C bond with formation of $NH_3^+-CH_2$ and CO_2; with rise in temperature the intermolecular transfer of hydrogen is possible leading to the formation of methylamine which has been detected and the $NH_3^+CHCOO^-$ radical. (P.C.H.)

33230 PARAMAGNETIC RESONANCE STUDIES OF IRRADIATED ALKALI CYANATES. Owens, Frank James. Storrs, Conn., Univ. of Connecticut, 1968. 128p.

Thesis.

Single crystals of KCNO were irradiated at room temperature by γ rays from a ^{60}Co source. Two ESR spectra were observed in the crystals after the irradiation. One resonance was due to a spin ½ defect and displayed a hyperfine interaction with a nucleus of spin one. The maximum splitting of the hyperfine lines was 5.0 G. It was possible to abstract from the data the isotropic hyperfine parameter. This was 2.3 G. This spectrum is attributed to a neutral CN molecule. The molecule is believed to be rotating in the (110) and (1$\bar{1}$0) planes of the tetragonal unit cell of KNCO. To explain the observed isotropic hyperfine interaction, it was proposed that there was a configurational interaction between the ground state and the excited states of the molecule. The effect of this was to mix into the bond of the molecule some s wave function from the orbital of the unpaired electron. This resulted in some probability for the unpaired electron to exist at the nitrogen nucleus and thus explained the existence of a small isotropic hyperfine parameter. Another two line spectrum was due to a spin ½ defect in two inequivalent sites. The spectrum had axial symmetry and the magnetic z axis was along the [110] and [1$\bar{1}$0] directions of the unit cell. The value of $g_\perp$ was 2.019 and $g_\parallel$ was 2.006. The spectrum was believed to be due to an oxygen minus ion trapped at an anion vacancy. An a priori crystal field calculation assuming an anion vacancy as the trapping site for the O yielded a g value in good agreement with the measured value. A detailed study was also made of the growth and thermal annealing properties of the resonances. Both resonances were stable up to 100°C and their thermal decay followed a second order kinetics. Sodium cyanate showed paramagnetic resonances only after a 1-MeV electron irradiation at 77°K. A spin ½ axially symmetric one-line spectrum was measured. The measured $g_\parallel$ was 2.003 and $g_\perp$ was 2.009. The magnetic z axis of the defect was in the [111] direction of the rhombohedral unit cell. Optical absorptions in both NaNCO and KNCO were recorded after the 1-MeV electron irradiations at 77°K. Each crystal showed two bands. In NaNCO the bands were at 2.21 eV and 2.03 eV. In KNCO the bands are less well resolved and were at 2.21 eV and 2.02 eV. The bands in NaNCO were assigned to F_2^+ centers on the basis of analogy with observed bands in NaN_3 (which has the same structure as NaNCO) and the ability of the observed bands to be fit to the continuum theory of the F_2^+ center. (Disser. Abstr.)

33231 PRINT-OUT ELEMENTS AND PROCESSES EMPLOYING SAME. (to Battelle Development Corp.). British Patent 1,154,191. June 4, 1969. Priority date June 6, 1966, United States.

A radiation-sensitive print-out element is made up of radiation-sensitive crystalline polyacetylenic compounds (organic compounds containing at least two conjugated acetylenic groups) and carrier means, such as a supporting sheet, to which the crystals are held in fixed position. The polyacetylenic compounds are sensitive to one or more forms of radiation, and on exposure to radiation the crystals will provide a visual image on the print-out element (usually a photographic element) by virtue of a color change taking place in the crystals either instantaneously or after several hours or days. The device is particularly suited for use as the image-recording element in an electron microscope. (B.L.M.)

33232 CHEMICAL RADIATION DAMAGE IN CRYSTALLINE AMMONIUM DICHROMATE. Mohanty, S. R.; Chaudhuri, S. Ray (Utkal Univ., Bhubaneswar, India). Curr. Sci. (India), 38: 252 (May 20, 1969).

Crystals of ammonium dichromate were irradiated with 2-MeV electrons to a dose of 50 MRad with the samples so distributed that their thickness in the direction of the beam was less than half the range of the electrons in the material. The damage induced in the substance was 1839 ppM Cr(III). (M.C.G.)

33233 METHOD FOR PRODUCING BRIDGED VINYL ALCOHOL–OLEFIN COPOLYMER MOLDINGS. Yoshitake, Toshihiko (to Kurashiki Rayon Co.). Japanese Patent 1969-933. Jan. 17, 1969. Filed Mar. 16, 1965.

The method proposed, employing ionizing radiation, produces moldings (including film, fiber, sheet, etc.) of a bridged vinyl alcohol−olefin copolymer, having superior chemical resistance, moisture permeability, heat resistance, and mechanical properties. The molding of vinyl alcohol−olefin copolymer is swollen about 20 to 100% by soaking in ethylene chlorohydrin or its aqueous solution. In this state, it is irradiated with ionizing radiation, to obtain the desired crosslinking. The irradiation may be done in the atmosphere of either an inert gas or air; the temperature during irradiation is from room temperature to 100°C; and the radiation dose is from 10^6 to 10^8 R. (NSA of Japan)

33234 METHOD FOR PRODUCING AN ION-EXCHANGE MEMBRANE. Tada, Syotaro (to Sumitomo Electric Industries, Ltd.). Japanese Patent 1969-1424. Jan. 22, 1969. Filed Nov. 11, 1964.

A fibrous cloth of polypropylene or glass, having high chemical resistance, is painted with ethylene−propylene rubber or the like as an ion-exchange membrane base. Then, sheets of cloth or paper that have absorbed a monomer of the vinyl system capable of introducing an ion-exchange group, are attached to the fibrous cloth on both sides. The sandwich-type arrangement is irradiated with ionizing radiation, in order to obtain a graft-polymerization between the ethylene−propylene rubber, polypropylene, and the monomer, oozing out of the sheets on both sides. Subsequently, the introduction of an ion-exchange group is done by conventional heat treatment. (NSA of Japan)

33235 METHOD FOR POLYMERIZING VINYL CHLORIDE. Sagane, Norio (to Sekisui Chemical Co.). Japanese Patent 1969-5873. Mar. 12, 1969. Filed Apr. 28, 1965.

The method proposed for polymerizing vinyl chloride employing radiation has the following advantages: a highly crystalline structure of the product due to the low-temperature process; a

high polymerization reaction velocity; a large G-value, and a high degree of polymerization. The vinyl chloride monomer is irradiated with ionizing radiation at a temperature below 0°C in the presence of a metal oxide such as oxides of Zn, Si, Mg, or Al. The ionizing radiation employed includes γ, β, and α rays, electrons, x rays, neutrons, or their mixed radiation with the dose rate of 10^6 to 10^3 R/hr. (NSA of Japan)

33236 ELECTRON SPIN RESONANCE STUDIES OF FREE RADICALS TRAPPED IN RARE GAS MATRICES AT LOW TEMPERATURES. Jackel, George Stewart. Durham, N. C., Duke Univ., 1968. 211p.

Thesis.

Free radicals produced by γ-irradiation of frozen solutions of tetra-atomic and penta-atomic molecules dispersed in rare gas matrices were studied by electron spin resonance. The topics of interest in the investigation included: the structure of and chemical bonding in the various free radicals produced, the effects of the radicals' environment on their structure and bonding, the nature of the rotation of the individual radicals within the matrices, and the mechanisms by which radical production and trapping take place. The molecules studied include ammonia (NH_3), phosphine (PH_3), arsine (AsH_3), deuterated arsine (AsD_3), stibine (SbH_3), phosphorous trifluoride (PF_3), methane (CH_4), silane (SiH_4), germane (GeH_4), and stannane (SnH_4). The matrices employed include Ar, Kr, Xe, and in one case, methane. A mixture of about 2% sample and 98% rare gas was frozen into a sample cell, and the resulting solid given a γ-irradiation of about two million R dose. Then the free radicals produced were studied using an ESR spectrometer. The irradiation and study were carried out in most cases at 4.2°K, though a temperature of 77°K was employed in a few cases. The hyperfine coupling observed for P atoms increases with increasing matrix atomic number, while that of As decreases. These phenomena can be explained in terms of the matrix shift theory of Adrian, and quantitative calculations using this theory indicate that the atoms are trapped in substitutional sites within the matrix. The g-factors of P and As atoms decrease linearly with increasing matrix atomic number. The radical PH_2 exists predominantly in its ground rotational state at 4.2°K in Xe in agreement with theoretical predictions, and a HPH angle of 105° is calculated, a slight increase from the 104° measured for PH_2 in Kr. An atomic As fine structure is reported for As in Kr. It is interpreted as the result of a small fraction of the atoms being trapped in a lattice site experiencing an axially symmetric crystalline field. The radical AsH_2 is detected for the first time using ESR. No Sb radicals were detected, but the presence of H atom resonances demonstrates the dissociation of SbH_3 in Xe. The methyl radical rotates freely in its ground rotational state in Xe at 4.2°K, but not in solid methane, where at 4.2°K it undergoes hindered rotation. When the temperature is lowered to 2.1°K, however, virtually all the radicals in the methane matrix drop into the ground rotational state. The structure of the silyl radical (SiH_3) in Xe is determined with a HSiH angle of 114°, an increase of 3° from the value for SiH_3 in Kr. The structure of the GeH_3 radical is determined from ^{73}Ge hyperfine measurements. For both Kr and Xe matrices, the HGeH angle is 115°. An attempt to determine the SnH_3 structure gave ambiguous results. A strong matrix effect was discovered in the production and trapping of radicals from the Group V hydrides of the form XH_3. Only the atoms X and H were found in Ar, a mixture of X, H, and XH_2 was found in Kr, and predominantly XH_2 and H with a trace of X atoms were found in Xe. These results are explained in terms of the hydrogen atoms formed in the dissociation during irradiation having a greater tendency to diffuse away from the site of dissociation as the matrix becomes less rigid, which it does in passing from Xe to Kr to Ar. (Disser. Abstr.)

33237 ENDOR STUDIES OF RADIATION-INDUCED DIBENZOCYCLOHEXADIENYL IN ANTHRACENE SINGLE CRYSTALS. Boehme, U. R.; Jesse, G. W. (Univ., Stuttgart). Chem. Phys. Lett., 3: 329-32(May 1969).

ENDOR spectra of the radioinduced dibenzocyclohexadienyl radical in anthracene were measured at 4.2°K. ENDOR lines of all the C-H protons were found. Measured spin densities are in agreement with the McLachlan theory and thus confirm the dibenzocyclohexadienyl radical. (auth)

33238 THE STABILITY OF HYDROGEN ATOMS IN IRRADIATED AQUEOUS SOLUTIONS. Ultee, C. J.; Kepford, C. R. (United Aircraft Research Labs., East Hartford, Conn.). Chem. Phys. Lett., 3: 337-8(May 1969).

The decay of H atoms in several γ-irradiated aqueous solutions was examined by ESR spectroscopy from 77 to 150°K. In perchloric acid the decay indicates the presence of two trapping sites. The more strongly trapped H atoms decay by a first-order process, apparently resulting from a slow release from the traps followed by a fast reaction. (auth)

33239 GAMMA INDUCED POLYMERIZATION OF 1,1,2-TRICHLORODIENES. Ito, Katsukiyo; Matsuda, Tatsuo (Government Industrial Research Inst., Nagoya, Japan). Kobunshi Kagaku, 26: 326-30(Apr. 1969). (In Japanese).

1,1,2-Trichloropentadiene-1,3 (TCP) and 1,1,2-trichloro-3-methylbutadiene (TCMB), which are methyl derivatives of 1,1,2-trichlorodienes, were synthesized, and the γ-induced polymerization of these monomers both in the liquid and the solid phases was studied. In the bulk polymerization, TEP was polymerized in the liquid phase at 25°C, but TCMB did not polymerize. These dienes were found to copolymerize with styrene (St). The reactivity ratios for the copolymerization of the above two dienes and 1,1,2-trichlorobutadiene (TCB) at 25°C were obtained as the following: TCP-St : $r_1 = 0$, $r_2 = 1.2$; TCMB-St : $r_1 = 0$, $r_2 = 0.7$; TCB-St : $r_1 = 1.75$, $r_2 = 0.15$. In the solid phase only TCB was copolymerizable. It seems from the above results that the methyl group in 1,1,2-trichlorodiene has significant effects steric hindrance. (NSA of Japan)

33240 ANION FORMATION IN ORGANIC ESTERS γ-IRRADIATED AT LOW TEMPERATURE. David, C.; Janssen, P.; Geuskens, G. (Univ. Libre, Brussels). Radiochem. Radioanal. Lett., 1: 129-32(June 1969).

Anions with a characteristic broad absorption band at 450 nm were observed in aliphatic saturated and unsaturated esters irradiated at 77°K either pure or in methyltetrahydrofuran or butyl chloride glasses. (auth)

33241 EFFECTS OF HIGH-ENERGY RADIATION ON THE LIPIDS OF FISH. Dubravcic, M. F.; Nawar, W. W. (Univ. of Massachusetts, Amherst). J. Agr. Food Chem., 17: 639-44 (May-June 1969).

The volatile compounds formed in the lipid fraction of mackerel by gamma irradiation under vacuum at 0.3, 2, and 6 Mrads and at 0 and 25°C, were investigated. Using gas chromatography and mass spectrometry, 56 compounds, most of which were not reported previously, were identified. Radiolytic products included the normal alkanes C_1 to C_{17}, the 1-alkenes C_2 to C_{17}, the alkadienes C_{12} to C_{21}, the internally unsaturated alkenes C_{14} to C_{21}, the C_{17} triene, the C_{11} alkyne, and the C_{16}, $C_{16:1}$, and $C_{18:1}$ normal aldehydes. Quantitative analysis demonstrated that the major products of irradiation were the longer-chain compounds, probably originating from radiolytic cleavage of the fatty acids near the carbonyl groups. (auth)

33242 RECOVERY AND MEASUREMENT OF VOLATILES FROM LIPIDS: HYDROCARBONS IN IRRADIATED FATS. Nawar, W. W.; Champagne, J. R.; Dubravcic, M. F.; LeTellier, P. R. (Univ. of Massachusetts, Amherst). J. Agr. Food Chem., 17: 645-8(May-June 1969).

Techniques are described for the isolation and quantitative measurement of a wide range of volatile compounds in lipids. The higher-boiling compounds are collected by cold-finger vacuum distillation and their quantities in the fat are determined by relating their gas chromatographic peak areas to that of an appropriate internal standard. The lower-boiling compounds are recovered on a short precolumn packed with stainless steel helices, which can be fitted inside the gas chromatographic oven before the inlet of an alumina column. Recovery data are given for a series of hydrocarbons from C_1 to C_{22}. The methods described were used mainly for the measurement of hydrocarbons in a number of irradiated fats, but can also be applied for the analysis of other classes of compounds. (auth)

Radiochemistry

33243 γ-RAY SPECTRA OF SOME γ-EMITTING NUCLIDES USED AS THE ACTIVE INGREDIENT OF RADIOPHARMACEUTICALS. Hasegawa, Akira; Kido, Yasumasa (National Inst. of Hygienic Sciences, Tokyo). Eisei Shinkenjo Hokoku, No. 86, 119-21(Dec. 1968). (In Japanese).

Typical spectra of radiation emitted from ^{51}Cr, ^{57}Co, ^{59}Fe, ^{60}Co, ^{86}Rb, ^{125}I, ^{131}I, mock ^{131}I, ^{131}Cs, ^{197}Hg, ^{198}Au, ^{203}Hg, and reference standard of ^{60}Co are presented. (NSA of Japan)

Separation Processes

Refer also to abstracts 33141, 33142, 33148, 33316, 34462, 34491, 34492, and 34887.

33244 (ARH-733) PROCESS FOR RECOVERY OF RHODIUM, PALLADIUM, AND TECHNETIUM FROM AGED REPRO-

CESSING WASTES AT HANFORD. Panesko, J. V. (Atlantic Richfield Hanford Co., Richland, Wash.). Aug. 1968. 65p. Dep. CFSTI.

Anion exchange was the only method investigated that quantitatively sorbed rhodium, palladium, and technetium from aged Purex supernatant wastes. Rhodium and technetium were removed from loaded resins during successive elutions with 1, 3, and 8M HNO_3, while most of the palladium remained on the resins. Palladium was subsequently eluted with 10M NH_4OH. A laboratory demonstration of this process using Amberlite IRA-401 and Amberlite XE-238 resulted in a nitric acid solution containing 8 g of crude rhodium and 19 g of crude technetium, and an ammonium hydroxide product solution containing 19 g of crude palladium. Rhodium and technetium were readily separated from each other by precipitation. An alternative process was based on the selective sorption of palladium on a column of methyltricaprylylammonium chloride (MTC) sorbed on Plaskon. Rhodium and technetium were quantitatively recovered from the effluent by Amberlite XE-238. Conceptual recovery flow sheets are shown. The sizes of the MTC-Plaskon column and the XE-238 column were determined by loading data obtained from small 2-ml columns. Since a 2-ml column of MTC on Plaskon quantitatively sorbed palladium from 1200 bed volumes (BV) of waste solution, it was predicted that a 100-gal column would sorb 100% of the palladium from 10^5 gal of waste solution. Similarly, the observation that a 2-ml column of XE-238 quantitatively sorbed rhodium from 100 bed volumes of waste solution led to the prediction that a 1000-gal column would sorb 100% of the rhodium in 10^5 gal of waste solution. Ambient temperature and flow rates of 50 gpm were recommended for every step in the flow sheet. Suggestions for possible flow sheet improvements are given. (auth)

33245 (ARH-911) PROCESS FOR PURIFICATION OF FISSION PRODUCT RHODIUM, PALLADIUM, AND TECHNETIUM RECOVERED FROM AGED PUREX SUPERNATANT WASTES. Panesko, J. V. (Atlantic Richfield Hanford Co., Richland, Wash.). Dec. 1968. 20p. Dep. CFSTI.

Rhodium, palladium, and technetium were recovered from stored radioactive waste solutions by anion exchange. Because trace levels of ^{60}Co, ^{137}Cs, and ^{106}Ru were present in the product streams, purification processes were needed to separate rhodium, technetium, and palladium from these impurities. Six grams of rhodium containing 4,800 μCi of fission product impurities per gram were purified to contain only 0.10 μCi of ^{137}Cs, 0.05 μCi of ^{106}Ru, and 0.01 μCi of ^{60}Co per gram of rhodium. The level of radioactive ^{102}Rh in the purified rhodium product was 3 μCi per gram of stable ^{103}Rh. A purification scheme was also developed to remove ^{137}Cs, ^{60}Co, and ^{106}Ru from palladium anion exchange product solution. Seven grams of palladium containing 3,400 μCi of fission product impurities per gram were purified to contain less than 0.002 μCi ^{137}Cs, 0.235 μCi ^{106}Ru, and less than 0.004 μCi ^{60}Co per gram of palladium. Kilogram-scale purification flow sheets were projected by extrapolation of the data obtained during the gram-scale purification of rhodium and palladium. (M.C.G.)

33246 (CEA-R-3778) DECONTAMINATION BY FRACTIONAL DISTILLATION OF A RADIOACTIVE MIXTURE OF PERCHLORETHYLENE, BITUMEN, AND SLUDGES FROM CHEMICAL COPRECIPITATIONS. Lefillatre, Guy; Hullo, Raoul (Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule). May 1969. 23p. (In French). Dep.

It is not possible to incinerate contaminated organic waste containing chlorine produced at the Marcoule Center. The only valid method for these solvents of average activity is fractional distillation. A pilot fractional distillation plant designed for decontaminating the residual solvents produced by the Center's Waste Processing Station is described. These contaminated solvents come from the decontamination of a screw extrusion apparatus with perchlorethylene; this equipment is used for coating radioactive sludges with bitumen. The pilot plant operates discontinuously and is used to decontaminate perchlorethylene, to separate the perchlorethylene from the water, and to process the distillation residue. The electrically heated boiler is fitted with a removable base in the form of a disposable container. The decontamination factor for the installation is 3.4×10^6 when solvents with a specific activity of 0.23 Ci/m^3 are used. The average flow-rate for a distillation run is 10 liters/hr at atmospheric pressure, and 21 liters/hr at a residual pressure of 40 torr. The decontamination factor for the installation is better at atmospheric pressure than in a vacuum. (auth)

33247 (DOCKET-50201-14) WEST VALLEY REPROCESSING PLANT. Quarterly Report, January 1-March 31, 1969. (Nuclear Fuel Services, Inc., West Valley, N. Y.). Apr. 28, 1969. 16p. Dep. CFSTI.

The processing of the highly enriched uranium fuel from Consolidated Edison's Indian Point reactor was completed and processing of NPR Lot XII begun. The mechanical and chemical operations are discussed. Nuclear fuel status, waste, environmental monitoring, facility performance and modifications, and unplanned shutdowns are considered. (M.C.G.)

33248 TEORETICHESKIE OSNOVY RADIOMETRICHESKOGO OBOGASHCHENIYA RADIOAKTIVNYKH RUD. (Theoretical Bases of Radiometric Enrichment of Radioactive Ores). Mokrousov, V. A.; Gol'bek, G. R.; Arkhipov, O. A. Moscow, Izdatel'stvo Nedra, 1968. 168p.

The theoretical bases of the radiometric separation of radioactive ores are examined. Physical aspects of this enriching process are discussed. Designs of radiometric separators and electronic equipment are presented. The properties of ores having an effect on radiometric enrichment are discussed. Significant attention is devoted to the methodology of radiometric enrichment of ores that possess natural radioactivity. The method of analysis of the technological results of radiometric separation is presented. (96 references). (tr-auth)

33249 REMOVAL OF IODINE FROM REPROCESSING-PLANT EFFLUENTS. Rodger, Walton A.; Reese, Stanton L. (Nuclear Safety Associates, Rockville, Md.). Reactor Fuel-Process. Technol., 12: 173-80 (Spring 1969).

The effects of iodine on reprocessing plant design and methods available for the control of iodine emissions are considered. The break-even point on capital expenditures to remove iodine was estimated. It was concluded that for larger plants (5 metric tons/day) it will be economical to install iodine-removal systems to permit processing at about 150 days cooling. For 1 metric ton/day plants it may be cheaper to handle the problem simply by cooling an additional month. (M.C.G.)

33250 FUEL REPROCESSING: COMMERCIAL EXPERIENCE. Abrams, L. A. (NUS Corp., Rockville, Md.). Reactor Fuel-Process. Technol., 12: 181-94 (Spring 1969).

The commercial West Valley Fuel Processing Plant uses the chop-leach solvent extraction process. Most feed material for the plant is and will be in the form of low-enrichment (<5%) UO_2 spent-fuel assemblies from light-water reactors of both the BWR and PWR type. Commercial reprocessing experience is reviewed. An estimated cost analysis is included. (M.C.G.)

33251 THEORETICAL ASPECTS OF AMINE EXTRACTION. Frolov, Yu. G.; Ochkin, A. V.; Sergievskii, V. V. (Inst. of Chemical Engineering, Moscow). At. Energy Rev., 7: 71-138 (1969).

A review dealing with questions concerning the interactions which take place in the organic phase during amine extraction is presented. The position of amines is considered in the general classification of extraction agents and the principal parameters determining the relationship between the extraction properties of amines and their structure: the basicity of amines and the intramolecular bond in amine salts. The association of amine salts, their solvation by different solvents and the influence of these factors on extraction are discussed. Reference is made to the results of investigations carried out in allied chemical fields. Possible correlations between the extraction properties of amines and parameters dependent on their structure and on the nature of the diluents used are considered. (467 references) (auth)

33252 THIN LAYER CHROMATOGRAPHY AS AN AID IN RADIOCHEMISTRY. SEPARATION OF ^{99}Mo AND ^{99}Tc. Seiler, H. (Univ., Basel). Helv. Chim. Acta, 52: 319-22 (1969). (In German).

Irradiated (thermal neutrons) NH_4 molybdate was dissolved in the minimum amount of 6M HNO_3 15 hr after irradiation and 2 μl portions were deposited on a TLC (thin layer chromatography) plate until 25,000 cpm were recorded with a thin-window G-M counter. The plate was 0.5-mm thick cellulose MN 300; solvent was n-butyl alcohol saturated with 1N HCl. Time for development was 1.5 hr. The plates were dried at 120°C for 20 min, then scanned with a Pb-shielded G-M counter with a 20 × 12 mm opening. The zones forming highest counting rates were dissolved and their γ emission measured with a single channel γ spectrometer. The band at the start is Mo (chemical tests also proved this), and the spot that moves near the solvent front is ^{99m}Tc, as also confirmed by half-life measurements of the spot. (BBB)

33253 GAS CHROMATOGRAPHIC ANALYSIS OF NIOBIUM, TANTALUM, ZIRCONIUM, AND HAFNIUM CHLORIDES. Pommier, Claude (Ecole Polytechnique, Paris); Eon, Claude; Fould, Henry; Guiochon, Georges. Bull. Soc. Chim. Fr., No. 4, 1401-8 (Apr. 1969). (In French).

The behavior of niobium, tantalum, zirconium, and hafnium chlorides in gas-liquid and gas-solid chromatography has been studied. Several molten metallic chlorides have been used as pure or mixture liquid phases. The degree of retention observed depends on the ability of the compounds of the melt to complex with the four volatile chlorides studied. The stability of the chlorocomplexes of a given metal with various chlorides increased in the order $Zn^{2+} < Sn^{2+} < Ag^{+} < Li^{+} < Na^{+} < Tl^{+} < K^{+} < Rb^{+} < Cs^{+}$. Complex formation kinetics was also a major factor in the chromatographic behavior of the compounds studied. Although the hexachloroniobate ion was more stable than the hexachlorotantalate ion, the tantalum chloride was eluted before niobium chloride on the LiCl–KCl eutectic and the two halides were completely resolved. The heat of solution of the gaseous chlorides has been determined in some cases. Complete separation of $NbCl_5$, $TaCl_5$, and $HfCl_4$ was easily obtained on graphite or graphited carbon black. Partial separation of $HfCl_4$ and $ZrCl_4$ was obtained with difficulty. A new injection system for solid samples is described. It introduces the samples in sealed tubes and may be used with catharometer without base line drifting. (auth)

33254 ULTRA-PURIFICATION OF WATER FROM LITHIUM, BERYLLIUM, AND BORON. Dufaure de Citres, Jean (Centre National de la Recherche Scientifique, Orsay, France). Bull. Soc. Chim. Fr., No. 4, 1072(Apr. 1969). (In French).

A fractional crystallization method of water purification in Li, Be, and B has been perfected for the study of nuclear reactions in oxygen. Concentrations of 2×10^{-11} g of B/g and less than 10^{-13} of Be, and Li/g were obtained. These amounts were measured by isotopic dilution with an ion sputtering mass spectrometer. (auth)

33255 STEAM DISTILLATION OF SOLVENTS WITH URANIUM SALT ADDITION. Auchapt, Pierre; Girard, Bernard; Sautray, Roger (to Commissariat a l'Energie Atomique). U. S. Patent 3,445,346. May 20, 1969. Priority date Dec. 31, 1963, France.

Solvents of the type employed in the nuclear industry were decontaminated by steam distillation of the solvent to which had been added a U salt. The salt was added in such quantity that the total U content did not exceed 20 g U/liter. The distillation was carried out at 100 to 160°C and at either atmospheric pressure or from 50 to 400 mm of Hg. (Offic. Gaz.)

33256 PROCESS FOR PURIFICATION OF YTTERBIUM. Rombau, Paul A. (to Produits Chimiques Pechiney-Saint-Gobain). U. S. Patent 3,446,576. May 27, 1969. Priority date June 13, 1966, France.

Ytterbium can be separated from rare earth metals such as Tm and Lu, by reaction of the rare earth metal compounds in a trivalent state with a Sa compound in the bivalent state in an alkaline medium so that the trivalent Yb is reduced to a soluble bivalent compound while other rare earth compounds remain insoluble in the alkaline medium. The separated solution of the Yb compound is oxidized to reconvert the compound of Yb to a trivalent state while the residue containing the insoluble compounds of Tm and Lu can be separated by conventional techniques. (Offic. Gaz.)

33257 IMPROVEMENTS IN OR RELATING TO PUNCHING MACHINES. Manevy, Georges (to Commissariat a l'Energie Atomique). British Patent 1,153,237. May 29, 1969. Priority date Dec. 1, 1966, France.

A process and an apparatus are described for separating PuF_6 from hexafluoride mixtures containing UF_6 by mixing the hexafluorides with CO_2 at a temperature between 150 and 500°C under a pressure between 0.5 and 4 bars to cause preferential reduction of the PuF_6, collecting the PuF_4, and cooling the remaining gaseous mixture to a temperature low enough to condense the UF_6 while the other products remain gaseous. The device consists of a vertical reaction vessel for injecting the fluoride mixture and CO_2 into the lower portion, conduit means from the upper portion for cooling the gases from the reactor, and valve means at the bottom of the vessel for collecting the powdered PuF_4. (B.L.M.)

33258 METHOD OF EXTRACTING METAL VALUES, ESPECIALLY FISSILE NUCLEAR MATERIALS, BY MEANS OF AN ORGANIC EXTRACTION MIXTURE. (to Gesellschaft fuer Kernforschung mbH). British Patent 1,154,875. June 11, 1969. Priority date Sept. 25, 1965, Germany.

A method is described for extraction of metal values, particularly U, Pu, and Th, from aqueous solutions by contacting the solutions with a mixture substantially insoluble in water containing a phosphoric acid ester, an organic amine or an organic ammonium compound, an inert organic diluent, and a carboxylic acid derivative. (B.L.M.)

33259 VIZMUTIOL AS THE REAGENT FOR SELENIUM AND TELLURIUM. Navratil, O.; Sorfa, J. (Purkyne Univ., Brno). Collect. Czech. Chem. Commun., 34: 975-83(Mar. 1969).

Extraction of the complexes of selenium and tellurium with Vizmutiol II (HA) indexed as 2-mercapto-4-phenyi-Δ^2-1,3,4-thiadiazoline-5-thione, its dependence on the acidity of the aqueous phase, on the original concentration of the reagent, and on the type of organic solvent, was investigated. The extractable complex SeA_4 was formed in acid medium. The possible formation of complex $SeOA_2$ cannot be precluded. It was not possible to prove the existence of analogical complexes of tellurium. (auth)

33260 EQUILIBRIUM STUDIES OF ACTINIDE METAL IONS AND ZIRCONIUM PHOSPHATE EXCHANGER. Wiedenheft, C. J. (Mound Lab., Miamisburg, Ohio). J. Inorg. Nucl. Chem., 31: 1859-1863(June 1969).

Equilibrium measurements between zirconium phosphate exchanger and several of the actinide metal ions in acidities up to 8M are reported. Measurements were obtained from both HNO_3 and HCl solutions. From the results with Th^{4+}, U^{4+}, UO_2^{2+}, Pu^{4+}, and PuO_2^{2+} ions it was concluded that the practical use of zirconium phosphate for separations is a complicated function of both pH and metal ion concentration. Distribution coefficients for many ions are only valid at the concentration at which they were determined. This also indicates that separation factors K_{DA}/K_{DB} are, in general, not constant and depend on each metal ion concentration. Therefore, useful distribution coefficients should be given both as a function of pH and metal ion concentration. (P.C.H.)

EARTH SCIENCES

Geology and Hydrology

Refer also to abstract 33364.

33261 (BNWL-1047) RADIOLOGICAL STATUS OF THE GROUND WATER BENEATH THE HANFORD PROJECT, JULY-DECEMBER 1968. Denham, D. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1969. Contract AT(45-1)-1830. 20p. Dep. CFSTI.

An evaluation of ^{106}Ru and ^{3}H concentrations measured in the Hanford Area groundwater during the last half of 1968 shows that the zones of detectable contamination extend in a southeasterly direction from 200-E Area as observed in the past. The few locations from which groundwater samples exceeded the respective CG's for ^{106}Ru and ^{3}H were all within either the 200-E or 200-W Areas or their respective fenced disposal sites. No radioactivity was detected consistently in any confined groundwater aquifer more than 5 miles down-gradient from the 200 Area disposal sites. The highest-average measured concentration in unconfined groundwater within or near the 100 Areas (Well 699-71-77) was less than 10% of the CG for ^{51}Cr (2000 pCi/ml). Some nitrate ion (NO_3^-) concentrations were above the Public Health Service recommended drinking water limit of 45 ppM (NO_3^-). The most probable ground-water flow paths are shown using field-measured groundwater potentials. In general, groundwater flow is from the Chemical Separation Areas to the Columbia River. (auth)

33262 (NTS-1) PRELIMINARY GEOLOGIC SECTION FROM PAHUTE MESA, NEVADA TEST SITE, TO ENTERPRISE, UTAH. Open-File Report 1967. Barosh, P. J. (Geological Survey, Denver, Colo.). [Aug. 30, 1967]. Contract AT(29-2)-474. 39p. (USGS-474-25). Dep. CFSTI.

Includes Charts.

The 154-mile long geologic cross section trends nearly perpendicular to the structural grain of the Basin-Range province in Nevada, and in Utah extends eastward into the transition zone between the Basin-Range and Colorado Plateau provinces. The structure is characterized by complex thrust faults, involving uppermost Precambrian to lower Mesozoic sedimentary rocks, and normal faults which cut the thick sequence of Tertiary volcanic rocks as well as older rocks. Some of the normal faults are the result of caldera collapse. The principal normal faults trend northerly west of Delamar, Nev., and form north-trending basins and ranges. Farther east the principal faults trend northwesterly, and form a moderately rugged highland rather than distinct basins and ranges. The uppermost Precambrina-Paleozoic strata thin markedly eastward across the region. The pre-Pennsylvanian sedimentary rocks vary from 32,500 feet in thickness at the Nevada Test Site to 4,500 feet in the Beaver Dam Mountains in western Utah. Thick Mesozoic deposits, similar to those of the Colorado Plateau, are present in western Utah, but are represented in eastern Nevada by only thin patches of Triassic rock. (auth)

33263 PRINCIPAL ELEMENTS IN ABSOLUTE FISSION TRACK DATING OF BASALTS OF SOUTHERN INDOCHINA. Carbonnel, J. P. (CNRS, Paris); Poupeau, G. Earth Planet. Sci. Lett., 6: 26-30(Apr. 1969). (In French).

Fission track dating has been applied to basaltic zircons from Bo Kéo (Cambodia) and Xuan Loc (South Viet Nam). Evidences have been drawn of two important eruptive stages, respectively, 1.25 and 0.65 Myr ago, in agreement with geologic and paleomagnetic data. (tr-auth)

33264 AGE DETERMINATIONS OF DEEP-SEA SEDIMENTS: A COMPARISON OF THREE METHODS. Dymond, Jack (Columbia Univ., Palisades, N. Y.). Earth Planet. Sci. Lett., 6: 9-14 (Apr. 1969).

Potassium-argon ages determined on glass shards from deep-sea volcanic ash layers are compared with paleomagnetic and $^{230}Th/^{232}Th$ age determinations. In three cores K-Ar ages agree satisfactorily with ages inferred from paleomagnetic studies. Ages on eight ash layers in a fourth core, however, are significantly older than the paleomagnetic ages. In the same core $^{230}Th/^{232}Th$ measurements indicate a sedimentation rate slower than that given by the paleomagnetic results but approximately in agreement with the rate given by the K-Ar results. One possible explanation for the discrepancies in this core is that the direction of remanent magnetization was not permanent at the sediment-water interface but was locked in at a depth of approximately 1½ meters. (auth)

33265 URANIUM-SERIES DATING OF PLEISTOCENE MOLLUSCAN SHELLS FROM SOUTHERN CALIFORNIA: AN OPEN SYSTEM MODEL. Szabo, B. J.; Rosholt, J. N. (Geological Survey, Denver). J. Geophys. Res., 74: 3253-60(June 15, 1969).

Pleistocene molluscan shells from the marine deposits of southern California were dated by the uranium-series disequilibrium method. The closed system ages were calculated from the measured $^{230}Th/^{234}U$ and $^{231}Pa/^{235}U$ activity ratios. Because of discordances found between the ^{230}Th and ^{231}Pa ages of many of the shell samples analyzed, it was assumed that shells do not usually form an ideal closed system. A mathematical solution for an open system model that can compensate for the deviation of a sample from the closed system model is proposed. The average open system ages of the first terrace of San Pedro of the Palos Verdes Hills and the Dume terrace and terrace C at Point Dume were calculated to be near 85,000, 105,000, and 130,000 years, respectively. (auth)

33266 ELECTRON-MICROSCOPIC OBSERVATION OF ARTIFICIALLY PRODUCED ALPHA-RECOIL TRACKS IN ALBITE. Turkowsky, C. (Technische Hochschule, Munich). Earth Planet. Sci. Lett., 5: 492-6(Mar. 1969).

It is shown that recoil nuclei produced by alpha-decay give etchable tracks on albite (010) surfaces. After a short etching in 200°C NaOH small triangular pits are revealed in samples exposed to alpha-gravity. The pits are observed in an electron microscope. A very high natural background of similar pits was also found in unirradiated samples. The density of these background pits appears to be too high to explain as fossil alpha-recoil tracks; and they are probably caused by other defect processes in the albite. (auth)

33267 FISSION TRACK DATING OF ARCHAEOLOGICAL GLASS MATERIALS FROM JAPAN. Watanabe, N.; Suzuki, M. (Tokyo Univ.). Nature (London), 222: 1057-8(June 14, 1969).

This method of dating depends on the observation of fission tracks due to the spontaneous fission of ^{238}U atoms contained in the glass. These tracks disappear if the glass is heated above a critical temperature. It may be assumed that the density of the tracks is proportional to the lapse of time after the glass was either produced or last heated above the critical temperature, and to the density of the ^{238}U atoms in the glass. The latter can be determined from the density of tracks from ^{235}U atoms induced by bombarding the glass with a known dose of thermal neutrons. Application of the method to a piece of obsidian spearhead from Hokkaido is described and to an obsidian arrowhead and an obsidian flake from the same neighborhood, both having been subjected to a high temperature during their history. A further specimen investigated was a potsherd of a glazed bowl from Honshu. Details of the technique are given. Etching was carried out with HF, conical pits being formed where fission tracks intersected the polished surface. The density of spontaneous fission tracks was determined by counting the number of etch pits with an optical microscope. The same piece of specimen was then irradiated with thermal neutrons and the induced fission track density determined. The critical temperature for disappearance of fission tracks was also determined. Results are tabulated and discussed. (UK)

33268 CONCERNING THE INTERACTIONS THAT OCCUR BETWEEN RADON DECAY PRODUCTS AND AEROSOLS. Raabe, Otto G. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. M.). Health Phys., 17: 177-85(Aug. 1969). Contract AT(29-2)-1013.

The state of experimental and theoretical knowledge concerning the attachment of radon decay products to aerosols is reviewed. Particular emphasis is upon a new concept which predicts that attachment is proportional to the surface area of the aerosol particles for all particle sizes and for all but extremely high concentrations of radon. Aspects of the character and fate of radon decay products which have yet to be fully understood and which require further experimental studies are discussed. Employing the theory of a self-preserving particle size distribution for natural aerosols, a hypothetical form for aerosols in uranium mines is developed and employed to calculate the expected fractions of unattached radium A, B and C for various aerosol concentrations and equilibrium times. The results compare favorably with available experimental values. (auth) (UK)

Meteorology

33269 (ANL/ES-CC-4) CHICAGO AIR POLLUTION SYSTEMS ANALYSIS PROGRAM. Quarterly Progress Report No. 4. Croke, E. J.; Carson, J. E.; Gatz, D. F.; (and others) (Argonne National Lab., Ill.). Mar. 1969. Contract W-31-109-eng-38. 266p. Dep. CFSTI.

Hourly meteorological and weather information is recorded for use on the Argonne IBM 360-75 computer. Hourly emission data for approximately 75% of Chicago's total SO_2 production are recorded. Quantitative relationships among air pollution emissions, meteorological parameters, and ambient air quality are made. Retrieval systems are used for rapid analyses. Histograms of any desired variables are possible. A multiple source, computerized atmospheric dispersion model was formulated and programmed for the development of optimal incident control strategies and long-range abatement plans. An operations research study of urban power plant networks was completed. A system analysis of natural gas supply and urban gas distribution is progressing to evaluate the effectiveness, operational restrictions, and economics imposed on the use of natural gas as an alternative to high sulfur content fuels. Tracers were employed in the pollution study. (J.C.W.)

33270 FISSION PRODUCTS IN ANTARCTIC SNOW, AN ADDITIONAL REFERENCE LEVEL IN JANUARY 1965. Crozaz, G. (Univ. Libre, Brussels). Earth Planet. Sci. Lett., 6: 6-8 (Apr. 1969).

Radioactivity measurements at the South Pole are discussed. Test results are being correlated to fallout from nuclear tests in regard to time of test and depths at which maximum activities are found at several testing stations. Recorded results of fission products in the air at ground level from 1960 to 1966 are given and it is concluded that above a low activity level, modulated by the well-known seasonal fluctuations, a slight increase is apparent in 1963 and 1964. An important maximum is clearly evident in December to February 1965. It seems evident that the second maximum in long-lived β-activity is associated with the snow deposited during this time. Cesium-137 and strontium-90 isotopes are also measured. The behavior of the fallout is accounted for by the general behavior of world-wide fallout deposition and reflects the difference in the date, the latitude, and the altitude of the injections. (J.C.W.)

33271 OBSERVATION OF NUCLEAR DEBRIS FROM THE FRENCH NUCLEAR EXPLOSIONS OF JULY TO SEPTEMBER 1968. Mamuro, Tetsuo; Matsunami, Tadao. Annu. Rep. Radiat. Center Osaka Prefect., 9: 9-13(1968).

Gamma-ray spectrometry was made on several samples of rainwater collected in the latter half of 1968 in order to know how long it would take for the fresh nuclear debris produced in the Southern Hemisphere to become noticeable in rainwater in Japan. The method of age determination based on the activity ratio of ^{95}Zr to ^{95}Nb as a function of age was applied for a rainwater sample containing fresh debris from a French explosion. It was concluded that the fresh nuclear debris from the French explosions became noticeable in rainwater in Japan in 40 to 50 days. In the course of the observation, fresh nuclear debris from the Soviet venting underground burst of November 7, 1968 were also detected in rainwater about 10 days after the burst. (auth)

33272 AGE DETERMINATION OF NUCLEAR DEBRIS BY THE ACTIVITY RATIO OF ^{95}Zr TO ^{95}Nb. Mamuro, Tetsuo; Matsuda, Yatsuka. Annu. Rep. Radiat. Center Osaka Prefect., 9: 5-8(1968).

An experiment was made in order to confirm the possibility of determining the age of nuclear debris by measuring the activity ratio of ^{95}Zr to ^{95}Nb. The photopeaks due to ^{95}Zr 757 keV γ-rays and ^{95}Nb 766 keV γ-rays can be clearly resolved from each other by a Ge(Li) detector with high resolution. The agreement between calculation and experiment was fairly good. This method can be applied with appreciable accuracy for the age determination of nuclear debris in the age range from about 15 to 100 days. In the case of debris samples which are much depleted in volatile nuclides, such as highly radioactive fallout particles from an air burst, the age determinable by this method can be appreciably shortened. (auth)

33273 ^{238}Pu IN FALLOUT. Mamuro, Tetsuo; Matsunami, Tadao. Annu. Rep. Radiat. Center Osaka Prefect., 9: 1-4(1968).

The observed variation in the activity ratio of ^{238}Pu to ^{239}Pu plus ^{240}Pu in rainwater in Japan over the period from 1961 through 1968 seems to indicate that the influence of the ^{238}Pu released by the burnup of the nuclear auxiliary power generator (SNAP-9A) became noticeable within about 6 months and that variation in the isotope ratio with time is affected by nuclear debris produced in the latest explosions as well as by the ^{238}Pu released from the SNAP-9A generator. (auth)

Mineralogy and Exploration

33274 (CONF-680625-7) AVAILABILITY AND SUPPLY OF URANIUM CONCENTRATES. Lloyd, B. C. L. (Rio Tinto Zinc Corp., London (England)). [1968]. 8p. Dep.

From BNX/BNF Nuclear Power Meeting, Copenhagen, Denmark.

Present and future nuclear power generation in non-communist countries up to 1980 is related to uranium reserves at less than $10 per lb. U_3O_8. It is shown that the maximum production rate from known reserves is insufficient to meet the requirements, and that new reserves must be discovered and exploited in order to allow the present production rate of 20,000 tons U_3O_8 to be quadrupled by 1980. Exploration prospects are discussed, and trends in purchasing patterns are considered. (UK)

33275 (KY-581) VARIATIONS IN ^{234}U CONCENTRATION OF NATURAL URANIUM. Smith, R. F.; Jackson, J. M. (Paducah Gaseous Diffusion Plant, Ky.). June 25, 1969. 14p. Dep. CFSTI.

Uranium ore concentrates from sixteen world sources were analyzed to determine variations in the ^{234}U content of natural uranium. A spread of approximately 7.5% of the ^{234}U content was apparent among the various sources. The lowest concentration, 0.00500 ± 0.00002 wt % ^{234}U, was obtained on ore concentrate from Mines Development in Edgemont, South Dakota. The highest concentration, 0.00539 ± 0.00002 wt % ^{234}U, was obtained on Belgian Congo pitchblende. (auth)

33276 (RME-4106) PRELIMINARY RECONNAISSANCE FOR URANIUM IN CONNECTICUT, MAINE, MASSACHUSETTS, NEW JERSEY, NEW YORK, AND VERMONT, 1950 TO 1959. (Division of Raw Materials (AEC), Washington, D. C. Geological Survey, Washington, D. C.). Feb. 1969. 129p. Dep. CFSTI.

Information on uranium reconnaissance in Connecticut, Maine, Massachusetts, New Jersey, New York and Vermont for the period 1950 to 1959 is presented. Other data on types of minerals examined, radioactively encountered, mine information, and geology of the area being investigated are given. (J.C.W.)

33277 ON A NEW Ni-As MINERAL AND A REMARKABLE URANIUM MINERALIZATION FROM THE ANNA PROCOPI MINE NEAR PRIBRAM. Frenzel, Gerhard; Otteman, Joachim (Univ., Heidelberg). Neues Jahrb. Mineral., Monatsh., No. 11, 420-9 (Nov. 1968). (In German).

A paragenesis of U-pitchblende, coffinite, and other minerals from the Anna Procopi mine was studied because of a new mineral replacing niccolite. The cross and lengthwise sections of the coffinite have heavy SiO_2 crusts combined frequently with a white Ni deposit. The composition of the coffinite was determined as follows: UO_2, mean 74.4, variation 70.7, 79.1; SiO_2, mean 3.3, variation 1.8 to 5.0; CaO, mean 2.4, variation 2.1 to 2.9. Since the composition for $USiO_4$ is 81.80 UO_2 and 18.20 SiO_2, the mineral is SiO_2-deficient. The mineralization is illustrated with microphotographs showing the SiO_2 crust and white Ni contour. The reflection power of the coffinite is unusually high, resembling U-pitchblende, and suggests a partial loss of SiO_2 as well. (BBB)

33278 URANIUM PROSPECTING AND PRODUCTION IN SPAIN: THE HOYA DEL LOBO DEPOSIT. Com. Naz. Energ. Nucl., Notiz., 15: 68-71(May 1969). (In Italian).

Information on the present state of uranium prospecting, reserves and production in Spain is presented. In particular, the Hoya del Lobo deposit is described. (auth)

33279 URANIUM DISTRIBUTION IN ULTRAMAFIC INCLUSIONS FROM VICTORIAN BASALTS. Kleeman, J. D.; Green, D. H.; Lovering, J. F. (Australian National Univ., Canberra). Earth Planet. Sci. Lett., 5: 449-58(Mar. 1969).

The uranium distribution in all phases of nine lherzolite inclusions from the Newer Volcanics of western Victoria was determined using fission tracks. Primary clinopyroxene has a mean content of 0.30 ppm U in five of the inclusions, and two contain primary apatite with 35 ppm U. Secondary clinopyroxene and apatite crystallizing in equilibrium with glass formed from partial melting of the lherzolites have a much lower abundance. Partition coefficients calculated from the U contents in these secondary phases and the glass indicate that a liquid in equilibrium with the primary assemblage would have had to contain 25 to 75 ppm U. Since these abundances are at least ten times those of normal basalts, these inclusions could not have formed as accumulates from a basaltic magma, neither are they the residue from a previous episode of complete magma extraction. However

other inclusions containing clinopyroxene with a low U abundance could be accumulates or residua. A model for the uranium distribution in the upper mantle is based on the uranium abundances in the high U primary assemblage. It is consistent with estimates of the upper mantle uranium content, and the uranium contents of basalt magma series calculated from it are consistent with the reported abundances. The petrology and geochemistry of inclusions illustrate a mechanism for limited wall rock reaction, and suggest that potassium may be moved without U. (auth)

33280 AEC FUEL SURVEY INDICATES IMPROVEMENT IN URANIUM SUPPLY. Nucl. News, 12: No. 7, 14-16(July 1969).

A survey of the nuclear industry on fuel cycle arrangements completed and planned for nuclear power plants was made that updated the survey made in April 1968. Forty-five utilities reported on 83 nuclear plants with a total of 61,800 MW(e). Uranium producers and reactor manufacturers answered interrogations on supply arrangements, uranium prices and requirements, and nuclear plant startup schedules. (J.C.W.)

Oceanography

33281 BORON ISOTOPIC FRACTIONATION DURING CLAY ADSORPTION FROM SEA-WATER. Schwarcz, H. P.; Agyei, E. K.; McMullen, C. C. (McMaster Univ., Hamilton, Ont.). Earth Planet. Sci. Lett., 6: 1-5(Apr. 1969).

Seawater is enriched in ^{11}B with respect to terrestrial and volcanic inputs. It is proposed that this is due to an isotope effect during adsorption of boron by clay minerals from seawater. An experimental test of this hypothesis using illite indicates a fractionation of about 30 to 40 per mille, enriching ^{10}B in the clay. This is in approximate agreement with a value calculated assuming that the ocean is at an isotopic steady state. (auth)

33282 $^{234}Th/^{238}U$ RATIOS IN THE OCEAN. Bhat, S. G. (Tata Inst. of Fundamental Research, Bombay); Krishnaswamy, S.; Lal, D.; Rama; Moore, W. S. Earth Planet. Sci. Lett., 5: 483-91(Mar. 1969).

The activity of the short-lived ^{234}Th (half-life = 24 days) is found to be in marked radioactive disequilibrium with respect to the concentration of its parent, ^{238}U, in the top hundred meters of the seawater column; values above and below secular equilibrium exist. The mechanisms responsible for the observed distribution of ^{234}Th are discussed and their rates are evaluated. (auth)

Seismology

Refer also to abstracts 33262 and 34911.

33283 (NVO-99-11) COMPUTER PROGRAM FOR RESPONSE SPECTRA. DESCRIPTION OF COMPUTER PROGRAMS CURRENTLY IN USE IN THE STRUCTURAL RESPONSE INVESTIGATIONS. Schopp, Ken (Blume (John A.) and Associates Research Div., San Francisco, Calif.). May 1966. Contract AT(26-1)-99. 58p. Dep. CFSTI.

A computer program package is described that prepares digitized ground motion data for analysis on the CDC 1604, calculates the response of numerous single-degree-of-freedom systems to the motion, and generates plots in response spectra form. The ground motion is generated by underground explosions. The program package includes: SPLIT which rearranges digital data strings generated on the analog-to-digital conversion system for CDC 1604 use. It is written on an output tape for input to SHIFT which converts the data for input to RESPONSE. RESPONSE calculates the peak pseudo relative velocity for an array of single-mass single-degree-of-freedom elastic systems mathematically subjected to the input ground motion function. SPREAD plots RESPONSE output on a Cal Comp 11 inch plotter. (F.S.)

33284 (SC-M-69-332) ACOUSTIC WAVE EFFECTS PROJECT: AIRBLAST PREDICTION TECHNIQUES. Reed, Jack W. (Sandia Labs., Albuquerque, N. Mex.). May 1969. 97p. Dep. CFSTI.

Atmospheric lens effects can cause strong propagation of blast waves to great distances. This problem is reviewed and current best estimates of the pertinent parameters for predicting long-range propagations from nuclear cratering explosions are given. Definitions are given to concepts of standard explosion waves, underground burst transmission factors, row-charge effects, atmospheric focus factors, and damage estimators. (auth)

33285 QUEST FOR A P TRAVEL TIME STANDARD. Lilwall, R. C. (Univ. of Birmingham, Eng.); Douglas, A. Nature (London), 222: 975-7(June 7, 1969).

It is stated that the new standard seismological travel time tables due to Herrin et al., fail to predict the P travel times for some explosions with known epicenters and origin times; notably, the P waves generated by the Longshot (Aleutian Island) explosion arrived earlier than predicted at stations to the north of the Aleutian arc and later than predicted at stations to the south. This "bias" results in a mislocation by about 25 km when the Longshot epicenter is computed by standard methods, and its cause is usually attributed to the effects of structure beneath the firing site. The authors discuss further their earlier communication (Nature, 220: 469(1968)) in which they found little evidence for source bias. It is shown that the joint epicenter method (Douglas, Nature, 215: 47(1967)) can be extended to compute P travel times and station corrections which are in good agreement with observed travel times for events with known epicenters; it is also concluded that any postulated source bias is probably much less than thought, and that the failure of the Herrin tables to predict the Longshot travel times could have arisen because of the method of analysis. The analysis of data from 146 stations for 81 well distributed events is described; six of these events were explosions of known origin times and epicenters. The reliability of the travel times and station terms estimated by the joint method was investigated using seven explosions with known epicenters and three earthquakes with what were thought to be well determined epicenters. It is considered that there was probably some source bias at the Longshot and Bilby firing sites, but for Longshot this bias was much less than postulated. (UK)

ENGINEERING

Nuclear Explosions

Refer also to abstracts 33283–33285 and 33564.

33286 (AD-684918) METHOD OF CALCULATING RADAR REFLECTIVITY OF NUCLEAR CLOUDS. Robbiani, Raymond L. (Army Electronics Command, Fort Monmouth, N. J.). Nov. 1968. 29p. (ECOM-3049). CFSTI.

A method for calculating radar reflectivity of nuclear clouds is discussed. Assumptions relating cloud characteristics and data collection are explained and tables and curves depicting these data are presented. The calculation derives reflectivity by generating particle and moisture unit volumes of estimated reflectivity using collection data from previous tests and fallout prediction studies. (auth) (USGRDR)

33287 (NCG-TR-10) CONSTRUCTION TECHNIQUES AND COSTS FOR EMPLACEMENT OF NUCLEAR EXPLOSIVES IN DISTURBED MEDIA. Hair, J. L. (Army Engineer District, Fort Worth, Tex.). Mar. 1969. 77p. Dep. CFSTI.

Methods and preliminary cost estimating procedures considered applicable to nuclear explosive emplacement construction through disturbed zones associated with single, row, and array craters produced by nuclear explosives are described. These shafts would be used primarily for connecting row craters and for emplacement of additional devices to modify the geometry of existing craters. A secondary purpose would be to provide access to previously buried but undetonated devices. Projects being considered for construction by nuclear methods include dam construction, canal excavation, harbor construction, and quarrying operations. Cratering studies conducted in hard rock, clay shales, and cohesionless, granular materials such as desert alluvium show that the areas of disturbance in and around a crater formed by nuclear detonation may be categorized into zones according to ejecta, fallback, and rupture zones. Recorded data of actual reentry into these zones are very limited. Most of the available information that directly relates to crater excavations generally pertains to small-diameter holes (six inches and less) which have been rotary drilled. Techniques utilized for these investigations, together with those documented for drilling in glacial till, offshore drilling of unconsolidated sediments, and conventional shafting of bad ground, have been evaluated. Many techniques and/or combination of techniques using a multiple of equipment types were studied. Of these, the most applicable for excavation of shafts through crater zones appears to be variations of big hole rotary drilling and conventional mining. A description of these methods and the necessary equipment for their employment are listed. Cost analysis for excavating large-diameter bores through disturbed media zones in and near existing craters was surveyed in an attempt to arrive at some reasonable method for cost prediction. (auth)

33288 (PNE-806-F) ANALYSIS OF DATA ON GROUND MOTION AND CONTAINMENT. Project HANDCAR, SAFETY PROGRAM. Final Report. (Environmental Research Corp., Alexandria, Va.). Dec. 20, 1968. Contract AT(29-2)-1163. 52p. Dep. CFSTI.

Evaluations and predictions of containment and ground motion were made for the Handcar event, a nuclear detonation in dry carbonate rock. Ground motion data from 13 strong motion stations, six on hard rock and seven on alluvium, were compared to pre-shot predictions. The containment was evaluated to determine if appropriate measures had been taken to preclude unacceptable venting of radioactive isotopes to the atmosphere. Consideration was given to possible venting both at the time of the detonation and later when the underground cavity collapsed, forming a chimney. The evaluation of containment included analysis of the adequacy of the emplacement hole stemming, as well as the possible hazards resulting from the generation of non-condensable gases, primarily CO_2, as a result of decomposition of $MgCa(CO_3)_2$. The prediction that unacceptable venting of radioactivity to the atmosphere would not occur was substantiated by the test results. Post-shot exploration allows comparisons between predicted (using a yield of 12.0 kt) and observed values for many of the close-in effects of the Handcar event. The predicted and observed values for these close-in effects are summarized. (auth)

33289 LEGAL PROBLEMS OF NUCLEAR EXPLOSIVES ENGINEERING. Ehrlich, Thomas (Stanford Univ., Calif). Nucl. News, 12: No. 7, 42-5(July 1969).

The legal aspects of the Limited Nuclear Test-Ban Treaty are discussed. General standards are needed to measure whether radioactive debris from a Plowshare test, for example, would be "present" beyond a nation's borders since the treaty exempts underground explosions, but minute radioactive quantities may be vented into the atmosphere, drifting beyond the state where the explosion occurred. Radiation is a cumulative process and the standards set for dosage is doubtfully defined. Detection standards also need to be defined consistently by all nations. The agency to be responsible for the standards set forth is a legal problem. Under the present treaty the construction of the Isthmian Canal by nuclear excavation is illegal. New legislation would be required for this endeavor. (J.C.W.)

Facilities and Equipment

Refer also to abstracts 33325, 33565, 33940, 33941, 33972, 33973, and 34346.

33290 (CEA-R-3622) INSTALLATION FOR PRODUCING SEALED RADIOACTIVE SOURCES. Fradin, Jean; Hayoun, Charles (Commissariat a l'Energie Atomique, Saclay (France), Centre d'Etudes Nucleaires). Jan. 1969. 194p. (In French). Dep.

An installation, designed and built for producing sealed sources of fission elements cesium-137, strontium-90, promethium-147, ruthenium-106, and cerium-144, is described. The installation consists of sealed and protected cells, each being assigned to a particular radioisotope. The safety and the operational reliability of the equipment are the principal considerations which have governed this work. The installation, apparatus, and the various control devices are described. A review is presented of six years operation. (auth)

33291 (CONF-680625-4) PRECISION MANUFACTURE OF NUCLEAR COMPONENTS. Burrows, A. P. W. (Rolls-Royce Ltd., [Derby] (England)). [1968]. 5p. Dep.

From BNX/BNF Nuclear Power Meeting, Copenhagen, Denmark.

The limits, tolerances, and specification requirements of nuclear components for the civil reactor field are discussed, and the cost is related to the technical requirements. A number of examples of the limits worked to in nuclear component manufacture are given. The relationship of the designer to the manufacturer as it affects performance of the component in the plant, and the cost effect of correct interpretation by both parties is outlined. (UK)

33292 (NAA-SR-Memo-12282) FFTF VALVE EVALUATION. Brooks, B. P. (Atomics International, Canoga Park, Calif.). Feb. 1, 1967. Contract AT(03-3)-701. 23p. Dep. CFSTI.

The primary service rating of valves for the various FFTF service conditions was evaluated. A bibliography of documents representing an accumulation of liquid metal valve data and user experience is presented. Based on a tabulation of valves utilized in the several liquid metal systems shown in BNWL-CC-400, recommendations are made of valve concepts for the required service conditions. Reference to specific test or user data is noted to corroborate the recommendations. (auth)

33293 (NP-17904) ULTIMATE PRESSURE ANALYSIS OF DEEP END SLABS FOR PRESTRESSED CONCRETE PRESSURE VESSELS. Campbell-Allen, D.; Low, E. W. E. (Sydney Univ. (Australia). Civil Engineering Labs.). Jan. 1969. 48p. (R-108). Dep.

An analysis has been developed which describes the possible ultimate strength of deep slabs under internal pressure. The analysis assumes a mode of failure which has been shown to occur experimentally under some conditions and it is demonstrated that this assumption gives reasonable bound to the ultimate pressure for a considerable range of prestress. The analysis is based on an assessment of the strength of concrete under triaxial compressive stress and the data relating to strength under these conditions are reviewed. (auth) (Australia)

33294 (ORNL-4278) SAFETY ANALYSIS FOR THE THORIUM–URANIUM RECYCLE FACILITY. Anderson, J. W.; Bolt, S. E.; Chandler, J. M. (Oak Ridge National Lab., Tenn.). May 1969. Contract W-7405-eng-26. 160p. Dep. CFSTI.

The Thorium-Uranium Recycle Facility (TURF), at the Oak Ridge National Laboratory will provide the initial focus for the Thorium Utilization program, but the facility is designed and constructed to have a much broader application for demonstrating

and evaluating the economics and remote operability of experimental recycling of various fuels of importance in the AEC program. The TURF is to be used in developing a wide variety of processes for the several fuel types using the thorium cycle. It is intended to be useful over a long period, for it has sufficient space to accommodate the equipment for processing and fabricating two different types of fuel assemblies simultaneously. The processing methods to be developed are those that produce a low degree of fission-product removal and therefore require remote handling and operation. A safety analysis for the Thorium-Uranium Recycle Facility and the proposed operations and procedures is presented. The building and building services, the cell bank processing area, and process services are described with special emphasis on provisions for containment of hazardous materials. Provisions for handling liquid and gaseous waste and containment and safeguards for processing radioactive materials are discussed. Operating safeguards, control of personnel exposure, and radiation contamination control are analyzed. (auth)

33295 (ORNL-TM-2442) PRELIMINARY EXPERIMENTS WITH THE VISCO SEAL-PUMP CONCEPT IN TURBULENCE. Taylor, E. R. (Oak Ridge National Lab., Tenn.). July 1969. Contract W-7405-eng-26. 92p. Dep. CFSTI.

Preliminary experiments were conducted to determine the performance characteristics of large size visco seals functioning simultaneously as a gas seal and as a sealant fluid pump operating in turbulence. The visco seal-pump conceptual design, the use of the theory based on a static sealant, and the method of testing are presented with the results and evaluation. The preliminary experimentation indicates that the simplicity of the visco seal-pump concept has potential for meeting the high reliability requirements for reactor rotating machinery. (auth)

33296 (RT/CHI-(68)36) REMOTE APPARATUS FOR THE ANALYTICAL CONTROL OF THE EUREX REPROCESSING PLANT. De Carolis, M.; Fasolo, G. B.; Orsello, S.; Bardone, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1968. 55p. (In Italian). Dep.

Remote control apparatus was developed for the hot cells of the Eurex reprocessing plant to permit the normal analytical operations of density measurement, sampling of liquids, transfer of two non-miscible liquid phases, control of the activity of samples being transferred from the cells, and washing of the sample carrier. A general description is given for these remote-control devices including their operation. (J.S.R.)

33297 (SC-DR-69-56) A HIGH-VOLUME, REAL-TIME AEROSOL MONITOR. Neitzel, William E. (Sandia Labs., Albuquerque, N. Mex.). June 1969. 20p. Dep. CFSTI.

Research and development work is described for three generations of a high-volume (10 to 50 cfm) aerosol monitor for use in sampling the air in laminar flow clean rooms. The final developmental model has a helium-neon laser as a light source and has demonstrated a high sensitivity to light scattering from particulate contamination at sampling rates 50 to 100 times that of commercially available monitors. While additional testing would be required to analyze the response of the monitor/signal processing system to particle concentration and size effects, the feasibility of the unique design features of the aerosol monitor was demonstrated. This developmental monitor, when coupled to appropriate electronic signal processing instrumentation, is expected to provide industrial and medical users of clean rooms with accurate particle counts without the long lag in pickup detection and recording of low-volume monitors. (auth)

33298 (SC-DR-69-316) ACTIVATED CHARCOAL FILTRATION: A SUPPLEMENT TO HEPA FILTRATION IN CLEAN ROOMS AND WORK STATIONS. Mashburn, James C.; Sylvester, Robert T. (Sandia Labs., Albuquerque, N. Mex.). June 1969. 23p. Dep. CFSTI.

High-efficiency particulate air (HEPA) filters are used in laminar flow clean rooms and clean work stations. However, HEPA filters were not designed to remove gaseous vapors, such as the SO_2 and NO_2 constituents of smog, which can corrode or deposit undesirable films on electromechanical components being processed in particulate-free clean rooms. A feasibility study of the particulate/gaseous filtration capabilities of Type AC activated charcoal when used in series with HEPA filters is reported. An experimental-type clean bench was designed and constructed to demonstrate that an activated charcoal/HEPA filter combination could remove not only the airborne particulates but also adsorb gaseous vapors that might film or corrode the components being produced in clean rooms. (auth)

33299 EQUIPMENT COMPRISING A PROCESSING VESSEL SUCH AS A STEAM GENERATOR HAVING A SUPPORTING STRUCTURE WHICH ALLOWS FOR THERMAL VARIATION IN LENGTH OF CONNECTING PIPE LINES. (to Reactor Centrum Nederland). British Patent 1,154,709. June 11, 1969. Priority date Aug. 17, 1965, Netherlands.

Equipment is described which includes a processing vessel such as a steam generator, for receiving or delivering high temperature fluids by means of at least one rigidly coupled pipeline. The processing vessel is fixed to a foundation by connecting structures which can produce supporting forces in all directions and which permits rotation of the process vessel. The pipeline is arranged so that thermal expansion of the pipeline is accommodated by rotation of the vessel. (F.S.)

33300 TUBE SUPPORT MEANS FOR GAS-HEATED HEAT EXCHANGERS IN NUCLEAR POWER STATIONS. (to L and C Steinmuller GmbH). British Patent 1,155,360. June 18, 1969. Priority date Oct. 12, 1966, Germany.

A heat exchanger is described for use in vertical gas flues of nuclear power stations. The heat exchanger can be subjected to high pressures of cooling gases such as CO_2 which circulate through the reactor. The exchanger consists of an assembly of vertical banks of tubes bent into consecutive hairpins with each pair of neighboring banks carried by vertical steel supports standing between the tubes. Suspended spacers are positioned between each pair of neighboring banks. Each assembly of banks is clamped into a rigid block by horizontal tiebolts which extend across the full width of the assembly. (F.S.)

33301 HEAT EXCHANGER. (to Gebr. Bohler and Co. Aktiengesellschaft). British Patent 1,155,338. June 18, 1969. Priority date Nov. 28, 1966, Austria.

A heat exchanger for media having high heat transfer coefficients such as liquid metals is described. The heat exchanger consists of at least two conduits separated by at least one thermally conductive wall. The conduits accommodate heat transfer media at different temperatures. The separating wall between the different temperature zones consists of at least two closely contiguous layers each provided with one or more slits to absorb thermal expansion. The slits are arranged so that they do not register with each other to an extent which would establish a material connection between the media at different temperatures. (F.S.)

33302 HEAT-EXCHANGE ELEMENT. Menissier, Pierre (to Commissariat a l'Energie Atomique). British Patent 1,155,134. June 18, 1969. Priority date Nov. 10, 1965, France.

An element for a heat exchanger is described which consists of a number of curved plates in the form of arcs of circles of different diameters. The plates are radially spaced from each other and are disposed coaxially with respect to each other and to a central tubular frame. Axially extending tubular spacer elements are clamped longitudinally between adjacent plates of the assembly. The spacer elements extend beyond the ends of the plates and have diameter ends greater than the spacing between adjacent plates. The ends of adjacent spacer elements are joined and are placed along a radius of the element. (F.S.)

33303 UNCOUPLED DYNAMIC THERMAL STRESSES IN INFINITE FLAT PLATES WITH INSTANTANEOUS AND TRANSIENT INTERNAL HEATING. Johnston, Bradley M. (Univ. of California, Livermore). Nucl. Eng. Design, 9: 327-48(Mar. 1969).

The classical theory of thermoelasticity for infinitesimal displacements was used to study the stresses and displacements caused by heat generation in infinite single or multiple flat plates. The initial conditions required the particle velocity to be zero at time zero, and stress-free or no-displacement boundary conditions were used. The study ignores heat conduction and the coupling between the temperature and strain fields and assumes the material of the plates to be homogeneous and isotropic. The given temperature function is dependent upon the distance coordinate across the thickness of the plate and the time, but is independent of the spatial coordinates perpendicular to the plane of the plate. These assumptions make the problems one-dimensional. The method of characteristics is used to solve the simpler problems for which analytical solutions exist, and the method of finite differences is used with variable grid spacings when Young's modulus is temperature-dependent. One comparison is given between the analytical and numerical solutions. (auth)

33304 ANALYSIS OF ASYMMETRIC STIFFENED SHELL TYPE STRUCTURES BY THE FINITE ELEMENT METHOD. II. SIX DEGREE-OF-FREEDOM MODEL. Zudans, Zenons; Reddi, Mullapudi M. (Franklin Inst. Research Labs., Philadelphia). Nucl. Eng. Design, 9: 302-10(Mar. 1969).

A stationary principle, which includes independent rotational degrees of freedom, for the elastic continuum is presented. Corresponding set of finite element equations is derived for the case of

the flat, rectangular orthotropic, multilayer, stiffened panel. Some examples are given to illustrate the accuracy of the method. It is believed that this six degree-of-freedom model will in particular, be of importance for the analysis of tees and nozzles in nuclear vessels, as well as submarine, surface and aircraft structures. (auth)

33305 STEREOSCOPIC TELESCOPE FOR THE REMOTE VIEWING OF OBJECTS PLACED IN A SEALED EXAMINATION ENCLOSURE. Brebant, Charles; Labet, Jacques; Mosse, Pierre (to Commissariat a l'Energie Atomique). British Patent 1,155,390. June 18, 1969. Priority date Sept. 13, 1965, France.

A stereoscopic telescope is described for remotely viewing objects placed in a sealed enclosure which contains radioactivity. The telescope consists of a single tube which provides a passage through the enclosure wall, two identical optical systems are located in the tube in the wall. The tube contains radiation absorbing material which forms a staggered path for the light beam of each optical system. The optical system consists of mirrors for directing light rays along oblique paths in relation to the axis of the wall-penetrating tube. Prisms in the optical system receive light from the object in the enclosure. The telescope also has a binocular head which carries the control system for adjusting the focus of the telescope. (F.S.)

33306 TIME-DEPENDENT ROTATION-SYMMETRIC THERMAL STRESSES IN ANNULAR VESSELS COMPOSED OF TWO DIFFERENT LAYERS. Mai, W. (VEB Kernkraftwerksbau, Berlin). Kernenergie, 12: 21-4(Jan. 1969). (In German).

The time-dependent rotation-symmetrical temperature field in a finite cylinder, which consists of two different layers, was calculated. A method for the solution of pertinent two-dimensional thermal stresses was given. (tr-auth)

33307 LARGE GAMMA-RAY IRRADIATION EQUIPMENT. Imai, Takeshi; Oishi, Mineo (Tokyo Shibaura Electric Co.). Toshiba Rebyu, 24: 641-8(May 1969). (In Japanese).

A 35,000 Ci, ^{60}Co, gamma irradiator was installed at the Nagoya Research Institute of Industrial Technology. The equipment with many new features, was designed originally by the Institute and completed with Toshiba's cooperation, and represents one of the biggest dry-container-type irradiators in Japan. (NSA of Japan)

33308 A CALORIMETER APPARATUS TO MEASURE THE ENTHALPY DIFFERENCE OF HEAVY WATER. Nowak, E. S.; Chan, J. (Univ. of Western Ontario, London, Can.). J. Heat Transfer, 91: 235-40(May 1969).

A nonflow calorimeter apparatus to measure the enthalpy difference of saturated liquid heavy water from 100 to 350°F was designed and developed. The reliability of the apparatus and associated instrumentation was evaluated by conducting a series of measurements on the empty calorimeter and on the calorimeter when it contained a sample of saturated light water. The apparatus yielded information on the enthalpy differences of liquid light water corresponding to temperature changes of 40°F accurate to within ±0.4 percent and reproducible to ±0.1 percent. (auth)

33309 METHOD OF MANUFACTURING CONTAINERS OF FUEL ELEMENTS FOR NUCLEAR REACTORS. (to Commissariat a l'Energie Atomique). French Patent 1,365,377. Filed May 13, 1963.

The outer wall of the fuel container is prismatic with an even number of faces, which are provided with cooling fins arranged in a chevron pattern. In the manufacture of the container the outer edges of the fins have to be planed off in order to obtain equal height of the fins. Deformation of the fins by the forces exerted by the plane is prevented by filling the channels between the fins with a solid. To this end the container is immersed in a liquid having a suitable boiling point (e.g., water), and the liquid is solidified by lowering the temperature beneath the boiling point, the planing is performed on the solid block, after which the solid is liquefied. (NPO)

33310 FUEL ELEMENT FOR NEUTRONIC REACTOR AND METHOD OF FABRICATION THEREOF. Franco-Ferreira, E. A. (to United States Atomic Energy Commission). U. S. Patent 3,454,468. July 8, 1969.

An integral fuel pin and grid structure forms pin-type neutronic reactor fuel elements. Substantially cylindrical fuel pins are deformed at one end into a rectangular cross section to provide flat faces for metallurgically bonding the pins together in a fuel element while maintaining a spaced relationship along their remaining cylindrical portions. The bonded faces are then partially cut away and one of two alternative methods are utilized for closing the end of the pins. According to one method the remaining faces are brought together and closed along their abutting edges by welding. Another method utilizes a cap inserted into the open ends and bonded thereto. An integral structure of interconnected fuel pins is provided which is suitable for, but not restricted to, vented operation. (AEC)

33311 CONTAINER OF A FUEL ELEMENT FOR NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,420,290. Filed Jan. 12, 1965.

The outer wall of the fuel element container is provided with cooling fins arranged in a herringbone pattern. In order to prevent deformation of the fins by the forces exerted by the flowing coolant, each fin is fashioned in such a way as to have equal height along its whole length, with the exception of short regions near its extremities. Two transverse sections through the container are given, showing different ways in which the roots and the tips of the fins belonging to one herringbone series may be positioned. (NPO)

33312 METHOD OF ASSEMBLY OF Bi-METALLIC TUBES BY FUSION WELDING WITHOUT FILLER METAL. Brigot, Camille; Droussent, Roger (to Commissariat a l'Energie Atomique). British Patent 1,156,780. July 2, 1969. Priority date Aug. 25, 1966, France.

A method for joining two tubes by fusion welding without the use of a filler metal is described. Tubes to be joined are those used in circulating a corrosive gas such as those in a uranium isotope separation plant. Each tube consists of an outer tube formed of mild steel with a lining formed of a different metal such as an aluminum alloy. The tube lining is freed at each extremity and then the tubes are joined by fusion welding so that there will be no contact between the mild steel and the corrosive gas. (F.S.)

33313 PROCESS FOR THE SHEATHING OF TUBULAR NUCLEAR FUEL ELEMENTS. (to SNAM Progetti SpA). British Patent 1,156,977. July 2, 1969. Priority date Aug. 6, 1965, Italy.

A process for applying an internal protective sheathing on tubular fuel elements is described. The fuel can be either metallic uranium, uranium alloy, ceramic or metal-ceramic material containing uranium. The process consists of introducing a metal sheathing tube inside a fuel element. The temperature of the sheathing tube is from +30°C to −250°C. The tube is expanded by raising the temperature to room temperature and heating the interior of the sheathing tube while cooling the exterior of the fuel element to cause intermetallic diffusion between surfaces of the fuel element and of the sheathing tube. (F.S.)

33314 IMPROVEMENTS IN OR RELATING TO VAPOR GENERATORS. (to Gulf General Atomic Inc.). British Patent 1,157,251. July 2, 1969. Priority date Oct. 1, 1965, United States.

A steam generator for use in connection with the production of steam for driving turbines is described. The generator is especially useful in a gas-cooled power reactor. The generator consists of two heat exchange sections, the first consisting of a number of frusto-conical helix tubes nested adjacent to each other along a common axis which extends through each helix. A second heat exchange section is adjacent to the first section and consists of a number of fluid conducting elongated U-shaped tubes. The tubes have U legs parallel with a common axis and arranged annularly about the axis. A means is provided for directing a continuous radial flow of preheated fluid over the U tubes and then over the other set of tubes in a single pass for transferring heat to fluid flowing in both sets of tubes. (F.S.)

33315 APPARATUS FOR THE STORAGE OF RADIOACTIVE WASTE LIQUIDS. (to United Kingdom Atomic Energy Authority). French Patent 1,490,771. Filed Aug. 19, 1966.

An apparatus for the storage of radioactive waste liquids is described which comprises at least one storage-tank, preferably of stainless steel, means for the reduction in volume of the liquid by evaporation, and means to maintain the pressure in the interior of the tank below atmospheric pressure. The evaporation is effected by the heat developed by the exothermal radioactive disintegration of the fission products contained in the liquids. Additional heating and cooling are provided to control the temperature of the liquids. The tank is surrounded by a biological shield, the condenser for the vapor of the liquid and other accessories are located outside the shield for maintenance purposes. (NPO)

33316 FURNACE FOR THE MANUFACTURE OF FISSILE AND/OR FERTILE NUCLEAR FUEL CARBIDES. (to EURATOM). French Patent 1,466,233. Filed June 5, 1964.

A high frequency induction furnace for the manufacture or the reprocessing of nuclear fuel carbides by reacting a halide of a nuclear fuel metal with a reducing metal and carbon is described.

The furnace comprises a central open top hearth made of graphite into which the reaction components are introduced. The hearth is positioned within a supporting vessel which has a cover provided with an aperture for gas passage. A field concentration device is included which has a body with hollow walls surrounding the supporting vessel and adapted to lead the field to the walls of the hearth. The body is closed at its bottom end to form a support for the supporting vessel and extends towards the top of the furnace to form a condenser with hollow walls. The hollow walls of the body and condenser are provided with a cooling fluid. A quartz tube surrounds the field concentration device and induction heating means are provided which includes an induction coil surrounding the quartz tube and the hearth. (NPO)

33317 IMPROVEMENTS IN OR RELATING TO OBSERVATION PORTHOLES FOR RADIO-ACTIVE CHAMBERS. (to Saint-Gobain Techniques Nouvelles). British Patent 1,156,177. June 25, 1969. Priority date Aug. 6, 1965, France.

An improved window for a hot cell or glove box is described. The window consists of glass slabs having spaces between the slabs which are filled by a substance having a refractive index higher than air. The index substance is transparent and is introduced as a liquid but solidifies after being introduced into the window. (F.S.)

Heat Transfer and Fluid Flow

Refer also to abstracts 33300–33302 and 33314.

33318 (CTC-INF-546) THEORETICAL AND EXPERIMENTAL STUDY OF CONFINED VORTEX FLOW. Farris, G. J.; Kidd, G. J. Jr. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center. Oak Ridge National Lab., Tenn.). [1968]. Contract W-7405-eng-26. 27p. (CONF-690602-1). Dep. CFSTI.

From Joint Applied Mechanics Fluid Engineering Conference, Evanston, Ill.

The interaction of a vortex with a stationary surface was studied both theoretically and experimentally. The flow field examined was that produced by radially inward flow through a pair of concentric rotating porous cylinders that were perpendicular to, and in contact with, a stationary flat plane. The complete Navier-Stokes equations were solved over a range of tangential Reynolds numbers from 0 to 300 and a range of radial Reynolds numbers from 0 to −13, the minus sign indicating radially inward flow. In order to facilitate the solution, the original equations were recast in terms of a dimensionless stream function, vorticity, and third variable related to the tangential velocity. The general validity of the numerical technique was demonstrated by the agreement between the theoretical and experimental results. Examination of the numerical results over a wide range of parameters showed that the entire flow field is very sensitive to the amount of radial flow, especially at the transition from zero radial flow to some finite value. (auth)

33319 (DPST-69-327) HYDRODYNAMIC ASPECTS OF THE CRITICAL HEAT FLUX IN SUBCOOLED CONVECTION BOILING. Thorgerson, Eric John (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Apr. 1969. Contract AT-(07-2)-1. 191p. Dep. CFSTI.

Thesis. Submitted to Univ. of South Carolina, Columbia.

Two hydrodynamic models of subcooled convection boiling burnout were studied and tested. One model is based on the concept of a critical two-phase boundary thickness at burnout. The other model is based on the boundary layer separation under the influence of mass injection from the wall as developed by Kutateladze. An experimental program was conducted to determine the effect of hot spots on subcooled flow boiling burnout. The critical heat flux is related to the friction factor through Reynolds analogy between momentum and heat transport, demonstrating that the heat transfer mechanism near the critical condition is limited by turbulent convection. It is also shown that the void fraction in high subcooling, i.e., T_{sub} greater than 45°F, burnout is very low. Furthermore, pressure drop for the same condition is due almost entirely to friction effects. The boundary layer separation mechanism is found to compare favorably with results in the low subcooling region. The mechanism is extended qualitatively to the higher subcooling region. The boundary layer equation is solved for an annulus, but the results are not conclusive. The experimental program demonstrated that the hot spot burnout heat flux is a function of hot spot position and length, and a strong function of subcooling. (auth)

33320 (DSR-70318-58) UNSTEADY MOMENTUM FLUXES IN TWO-PHASE FLOW AND THE VIBRATION OF NUCLEAR REACTOR COMPONENTS. Yih, Tien Sieh; Griffith, Peter (Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.). Nov. 1968. Contract AT(30-1)-3496. 126p. Dep. CFSTI.

The steady and unsteady components of the momentum flux in a two-phase flow have been measured at the exit of a vertical pipe. Measured momentum flux data have been machine processed by standard random vibration techniques to obtain the power spectral density curves. From these curves, the predominant frequency and the rms value of the unsteady momentum flux have been obtained. The effects of the average flow velocity, volumetric quality, system pressure, flow channel size, and geometry on the unsteady momentum fluxes have been observed. It has been found that the fluctuation of momentum fluxes is important only in the low frequency range. The maximum values of unsteady momentum fluxes appeared in either the high void slug flow or the low void annular flow regime. The experimental results have been correlated and suggestions have been made for constructing the power spectral density curve of momentum fluxes under untested conditions. In the sample problems, using the experimental results, the effect of the unsteady momentum fluxes on a steam generator U-tube and a reactor fuel rod has been studied. The amplitudes of the structural vibrations resulting from the two-phase excitation have been found. In addition, it has also been found that there is a possibility of unstable vibrations owing to a nonlinear restoring force on the mechanical system. This nonlinearity is due to the unsteady component of the momentum flux in the flow past the system. In both examples, the major vibrations occurred in a narrow frequency band around the natural frequency of the mechanical system. (auth)

33321 (DSR-70586-63) FORCED-CONVECTION DISPERSED-FLOW FILM BOILING. Hynek, S. J.; Rohsenow, W. M.; Bergles, A. E. (Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering). Apr. 1969. 126p. Dep. CFSTI.

An investigation of the characteristics of dispersed flow film boiling is presented. Heat transfer data are presented for vertical upflow of nitrogen in an electrically heated tube, 0.4 in. I.D. and 8 ft long. Heat fluxes up to 18,000 Btu/ft^2-hr and mass fluxes up to 200,000 lb$_m$/ft^2-hr were investigated. By variation of the startup procedure, it was possible to operate in two distinct regimes of film boiling. By preheating the tube before introducing the flow, film boiling was observed throughout the test tube. If the flow was established before applying power, film boiling was initiated downstream of the inlet. For similar conditions, the local heat transfer coefficients were different in the two cases due to the different degrees of thermal nonequilibrium. The data for both regimes were satisfactorily predicted by a modified version of the nonequilibrium model presented in earlier reports. The model was also applied to available data for methane, propane, and water. By modification of the empirical constant governing the direct wall-to-droplet heat transfer, these data were generally predicted to within 10 percent. The tests were repeated with tight-fitting, full-length twisted tapes installed in the test tube. Considerable augmentation of the heat transfer was achieved, with the heat transfer coefficient being increased by as much as a factor of 3 with the tightest tape twist. For the higher mass fluxes, it was observed that the tape promoted droplet deposition to such an extent that a continuous liquid film could be reestablished on the wall near the test section exit. The tape-generated swirl flow did not improve the burnout condition, primarily due to the fact that a liquid streamer forms on the twisted tape. The semiempirical model gave a reasonable prediction of the heat transfer coefficient when the effects of the swirl flow were included. (auth)

33322 (EUR-4252(Pt.1)) HDP 2: A DIGITAL PROGRAM CALCULATING THE SURFACES AND THE EFFICIENCES OF A HEAT EXCHANGER COUPLED WITH A TURBINE AT NOMINAL POWER AND AT PART LOAD. PART I. DESCRIPTION OF THE CODE VERSION HD 2 CALCULATING THE NOMINAL POWER CHARACTERISTICS. Balz, W.; Bona, C.; Gecchelin, S. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1969. 57p. Dep.

The code HDP 2 is a digital program for calculating the surfaces and the efficiencies of a heat exchanger coupled with a turbine at nominal power and at part load. Steam cycles with or without reheating by the primary coolant may be treated. Arrangements of the reheater section of the heat exchanger are: in series with the superheater, in parallel with the superheater, or in parallel with the superheater, boiler, and economizer. The heat exchanger may be of the drum boiler or Benson boiler type. The primary coolant which in the actual code version may be OM 2 or HB 40 is assumed to flow on the shell side in counterflow to the steam or water. The code describes the version of HD 2 which treats the design calculations. (auth)

33323 (GEAP-5739) TWO-PHASE FLOW AND HEAT TRANSFER IN MULTIROD GEOMETRIES. AIR–WATER FLOW STRUCTURE DATA FOR A ROUND TUBE, CONCENTRIC AND

ECCENTRIC ANNULUS, AND NINE-ROD BUNDLE. Schraub, F. A.; Simpson, R. L.; Janssen, E. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Jan. 1969. Contract AT(04-3)-189. 214p. Dep. CFSTI.

The equipment and instrumentation for flow structure experiments of vertically upward air-water flow in a round tube, eccentric and concentric annulus, and a nine-rod array are discussed. The following quantities were measured for a series of runs: at one elevation, profiles of local void fraction, air linear velocity, and water linear velocity were obtained (isokinetic sampling technique); the film flow rate on solid surfaces (porous or perforated walls); local time-dependent liquid or vapor fraction (continuity probe); average void fraction (quick-closing valves); system temperature, pressure, and pressure fluctuations (thermocouples, Bourdon gage, and PACE transducers); mean air and water flow rates (rotometer and orifice and manometer, respectively); pressure drop (manometers); and wall shear probe (Preston impact tube). The quality varied from 11 to 62%. The total mass flow ranged from 0.12×10^6 to 0.70×10^6 lb/hr ft^2, resulting in superficial air velocities from 48 to 72 ft/sec and superficial water velocities from 7 to 23 ft/sec. The flows are in the annular–dispersed flow regime. Results from these data are presented on graphs and in tables. (auth)

33324 (SAN-651-94) ORGANIC WORKING FLUID BOILER INVESTIGATION. AEC ORGANIC RANKINE CYCLE TECHNOLOGY PROGRAM TOPICAL REPORT. Martz, J. L. (Sundstrand Aviation-Rockford, Ill.). [1968]. Contract AT(04-3)-651. 105p. Dep. CFSTI.

The design of a boiler loop and once through boiler tubes with various boiler tube internal geometries is presented. Heat transfer and stability tests established satisfactory analytical equations for predicting boiler heat transfer performance and established hydrodynamic stability design criteria for once through organic Rankine cycle boiler systems. Test hardware, instrumentation, test procedures, operating difficulties, and test results of a once through Dowtherm-A vaporizer heated by thermal radiation from electrical heaters are discussed. In predicting boiler heat transfer performance several boiling regions were considered. The Dittus–Boelter equation was used in the subcooled single-phase flow region. An original correlation of the form $(Q/A)_b = C\Delta T^n$ was used in the nucleate boiling regime. The Dengler–Addoms correlation was employed to predict film coefficients in the two-phase flow region. It was found that the analytical coefficients were underestimated by a factor of 1.4, with the superficial factor F = 1. In the bare tube runs the Dittus–Boelter equation predicted actual results within ±25%. Film coefficients in two-phase flow were within ±10% with F = 1.0 in Runs 1A and 1B and F = 1.4 in Run 1C. With the addition of a 0.25 in. concentric tube in the subcooled liquid region, orifices in the low quality end, and a spiral wire in the high quality end, film coefficients were found to be twice as high in the subcooled liquid region, since h is dependent on velocity in the Dittus–Boelter equation. Boiler stability tests were also conducted. Inlet throttling of the liquid to the boiler had no apparent effect on stability in any of the tests performed. (J.C.W.)

33325 (SAN-651-96) ORGANIC RANKINE CYCLE TECHNOLOGY PROGRAM. Quarterly Progress Report No. 12, January 1, 1969–April 1, 1969. Niggemann, R. E. (Sundstrand Aviation-Rockford, Ill.). Apr. 15, 1969. Contract AT(04-3)-651. 34p. Dep. CFSTI.

Loop No. 1, with the eutectic mixture of biphenyl and biphenyl-ether as the working fluid at a boiler outlet temperature of 700°F, was the only loop to be operated. The loop suffered a severe overtemperature resulting in extreme fluid degradation and the rupture of a weld. The test was subsequently terminated with an accumulated total of 6367 hours operation. The eutectic continued to show excellent stability up to the time that final shutdown occurred. Total degradation, linearly extrapolated to 10,000 hours, is only 0.126 per cent. This is higher than previously reported because new improved analytical methods have resulted in the discovery of additional high boiling point degradation products. Successful testing of the plain journals was performed and calibration data are complete. One successful run was made with the floating pad bearings, but a full speed rub occurred after four minutes operation. No significant damage resulted. The pump test rig was tested. Investigation of the head flow characteristics for the high flow rate jet condenser pump was completed. (J.C.W.)

33326 PREDICTION OF TUBE WALL TEMPERATURES WITH AXIAL VARIATION OF HEATING RATE AND GAS PROPERTY VARIATION. Bankston, C. A. (Los Alamos Scientific Lab., N. Mex.); McEligot, D. M. Nucl. Sci. Eng., 37: 157-62 (July 1969).

The superposition method for prediction of axial wall temperature variation, which has been specialized by Siegel, Sparrow, and Hallman, and by Hasegawa and Fujita, is presented in more general form. Operational utility of this form is demonstrated in a turbulent flow example with an alternate description of the basic solution for constant wall-heat flux. Application to gas flow problems with property variation is discussed, and results are presented for sinusoidal heat flux variation. (auth)

33327 INFLUENCE OF NUCLEAR RADIATION ON POOL-BOILING HEAT TRANSFER TO LIQUID HELIUM. Bowman, H. F. (Northeastern Univ., Boston); Smith, J. L. Jr.; Ziebold, T. O. J. Eng. Ind., 91: 501-7(May 1969).

Pool-boiling experiments were performed in helium from high purity copper which had been exposed to various amounts of fast neutron radiation. The residual effects of the radiation influenced the pool boiling in two ways: first by decreasing the thermal conductivity of the copper substrate; and second by inducing residual radioactivity in the copper. The changes in the conductivity influenced the unsteady heat conduction process associated with nucleate boiling. The residual radiation from the copper augmented the bubble nucleation in the superheated helium in a manner similar to a bubble chamber. The relative magnitudes of the two effects were influenced by surface smoothness. (auth)

33328 DIFFUSION OF DISINTEGRATION PRODUCTS OF INERT GASES IN CYLINDRICAL TUBES. Tan, C. W. (Copper Union for the Advancement of Science and Art, New York). Int. J. Heat Mass Transfer, 12: 471-8(Apr. 1969).

The problem of steady-state diffusion of the decay products resulting from the disintegration of an inert gas flowing through a cylindrical tube is considered. The disintegration products diffuse radially to the walls of the tube, where they are adsorbed. Three velocity distributions (uniform-, parabolic-, and Langhaar-) are considered and the respective solutions for the concentration distributions are obtained. Also presented are the $F(\mu)$ values for the respective velocity distributions. These values are needed in the determination of the diffusion coefficients of the disintegration products. (auth)

Isotope Technology

Refer also to abstracts 33146, 33290, 33307, 33342, 33386, 33564, 33573, and 34925.

33329 (AI-AEC-12822) LARGE RADIOISOTOPE HEAT SOURCE CAPSULE PROGRAM. Topical Report No. 6. Capsule Fabrication and Assembly Processes. Melillo, V. D. (Atomics International, Canoga Park, Calif.). Mar. 31, 1969. Contract AT(29-2)-2338. 97p. Dep. CFSTI.

The Large Radioisotope Heat Source Capsule (LRHSC) Program for the development of the technology for a high temperature (≥2000°F), long life (≥5 years) radioisotope heat source which can be used in the space environment is discussed. The program is concerned with the development of a tantalum alloy fuel capsule. Materials compatibility, fabrication processes and assembly procedures are being defined and the response of the capsule is being determined for conditions of biaxial creep, terminal velocity impact and burial. A description of LRHSC fabrication and assembly procedures is given. Fabrication details are presented for each of the capsule piece-parts with the exception of the T-111 structural shell, the fabrication of which was previously given. Cleaning and annealing practices for the capsule piece-parts are described and the capsule assembly procedures are detailed. (auth)

33330 (AI-AEC-12823) LARGE RADIOISOTOPE HEAT SOURCE CAPSULE (LRHSC). Seventh Quarterly Progress Report, January–March 1969. (Atomics International, Canoga Park, Calif.). May 1, 1969. Contract AT(29-2)-2338. 72p. Dep. CFSTI.

Special design modification for assembly of the instrumented fire test capsule was completed. Weld development of the 0.09 in. wall and the 0.10 in. wall T-111 structural shell to the T-111 structural end cap was completed. Fabrication of seven Pt–Rh barrier caps was completed. Assembly was completed of one impact capsule, three creep test capsules, creep capsule C standard, and the LRHSC fire test capsule. The original B5 capsule designated for strain rate testing was redesignated as a rupture capsule. The total diametral strain at the time of rupture was nearly 15%. The B7 capsule achieved 5% total strain. B6 capsule testing continues and creep capsule B-4a was tested to 5% strain in 195 hours. Fabrication of a new barrel for the Impact Facility to allow hot breech loading and testing without the graphite sabots and stripper previously employed was completed and the barrel installed. A launch abort fire test capsule

of the LRHSC creep C configuration was assembled, instrumented, and successfully tested. (J.C.W.)

33331 (BNL-13595) RADIONUCLIDE GENERATORS: PAST, PRESENT, AND FUTURE. Stang, L. G. Jr. (Brookhaven National Lab., Upton, N. Y.). Apr. 22, 1969. 151p. (CONF-690413-1). Dep. CFSTI.

From 3rd Annual Nuclear Medicine Meeting, Puebla, Mex.

Radioisotope generator systems are described. When a radioisotope undergoes radioactive decay the product may be a stable isotope in some cases or another radionuclide in another. The second radionuclide on decay can form either a stable nuclide or a third radionuclide. The chain is ultimately terminated by a stable isotope. There are presently 72 possible practical systems. New production methods and more chains are being realized currently. It is hoped that the medical personnel would ask specifically for the needed isotopic property and that the isotope can be provided. Seventy-two of the practical radioisotopic systems are listed. Information of the characteristics of a parent-daughter relationship is given. (J.C.W.)

33332 (BNWL-1115) POTENTIAL OF USING MIXED FISSION PRODUCTS AS A SOURCE OF ENERGY. Bolme, D. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). June 1969. Contract AT(45-1)-1830. 54p. Dep. CFSTI.

The amount of mixed fission products (waste byproducts obtained in the chemical reprocessing of nuclear fuels) potentially available through the year 2000 was estimated, their probable characteristics when packaged in a form suitable for long term storage described, and the potential usefulness of these packages as sources of thermal and gamma (radiation) energy assessed. The amounts potentially available depend upon the development of the nuclear (electric) power industry. Initial availability could be as early as 1975, substantial amounts (4800 packages per year) are expected to be available in about 1990. Packaging the waste will consist of converting the waste to a solid and depositing the solid in a metal cylinder which would then be welded shut. Typical package dimensions might be those of a 10 inch (diameter) schedule 40 stainless steel pipe $8\frac{1}{2}$ feet long with a filled height of 8 feet and a total weight of 1000 lb. The characteristics of the mixed fission product cylinders as sources of gamma irradiation are roughly those of a heavily self-shielded source of cesium-134 and -137 which is contaminated with enough cerium-praseodymium-144 to cause shielding problems during transport and handling. Gamma power delivered external to a cylinder containing 2 year old waste will be about 1020 watts including 240 watts from ^{137}Cs, 585 watts from ^{134}Cs, 100 watts from ^{106}Ru-Rh, 37 watts from ^{144}Ce-Pr and 58 watts from all other nuclides. Packaged mixed fission products are not expected to be useful in mobile irradiators because of the heavy shielding made necessary by the ^{144}Ce-Pr. Use of mixed fission products in stationary radiation facilities may be feasible for uses which require a source strength greater than that of 5 megacuries of cobalt and can tolerate large, bulky, diffuse sources. The packaged mixed fission products (cylinders) are not economically useful sources of thermal energy except, possibly, as a source of process steam for the plant which produces the cylinders. (auth)

33333 (DUN-SA-84) CLEAN ^{238}Pu FROM ^{237}Np IRRADIATION. Meichle, R. H.; Nosler, J. C. (Douglas United Nuclear, Inc., Richland, Wash.). May 20, 1969. Contract AT(45-1)-1857. 9p. (CONF-690609-18). Dep. CFSTI.

From 15th Annual Meeting of the American Nuclear Society, Seattle, Wash.

The results of prototypical neptunium irradiation tests have demonstrated the inherent capability for producing ^{238}Pu containing 0.3 to 0.5 ppM ^{236}Pu in the Hanford graphite-moderated production reactors. An irradiation test designed to further minimize higher energy neutron and gamma effects is expected to demonstrate the capability of efficiently producing ^{238}Pu acceptable for medical purposes—material containing only 0.2 ppM ^{236}Pu at time of discharge. The principles utilized at Hanford to reduce the buildup of gamma-emitting isotopes in ^{238}Pu can be applied to other operating reactors and to the design of isotope-producing reactors. (auth)

33334 (NYO-3740-3) PORTABLE CESIUM IRRADIATOR OPERATION IN WASHINGTON STATE, OCTOBER 1967-MARCH 1968. (Washington State Office of Nuclear Energy Development, Olympia). Apr. 1968. Contract AT(30-1)-3740. 156p. Dep. CFSTI.

The Portable Cesium Irradiator program of the State of Washington is described. The selection of the geographic locations within the state where the irradiator would be most effective in the stimulation of commercial interest was discussed. The first demonstrations for the irradiator were held in the Beaton-Franklin-Walla Walla County area. The unit was operated for two weeks with four food processing firms participating in the evaluation of the effects of radiation on their products. The survey did not reach any scientific or technical conclusions but was designed to assess public resistance, if any, to the consumption of a staple food that had been subjected to ionizing radiation. It was concluded that: the word "irradiated" instills no hesitancy for acceptance by the public but the phrase "treated by ionizing radiation" does; the U. S. Food and Drug Administration exposure rates have little or no effect on the control of bacteria or fungi present; the public could be taught better home storage methods; potatoes that have been "healed" and then irradiated stand up better over longer periods than those immediately treated after harvest; shelf life extension for potatoes must involve both disease control and sprout inhibition; and an effective quality control method must be employed to preclude adverse public reaction whether potatoes are irradiated or not. (R.C.K.)

33335 LONG RANGE PLANS FOR URANIUM ENRICHMENT. Com. Naz. Energ. Nucl., Notiz., 15: 89-99(May 1969). (In Italian).

The full text of the Euratom Report on Uranium Enrichment in Europe is given. (auth)

33336 SEPARATION DEMONSTRATION PLANTS FOR URANIUM ENRICHMENT. Becker, E. W.; Bier, W.; Frey, G.; Schuette, R. (Kernforschungszentrums, Karlsruhe, Ger.). Atomwirt., Atomtech., 14: 249-51(May 1969). (In German).

In order to make more accurate economic evaluations of the separation nozzle method, development and design studies were undertaken for a pilot plant with a separation output of 600,000 kg U/yr. The plant would supply light water reactors with a total capacity of 6000 MW(e) continuously with fuel. It would cost approximately 300 million DM and consume about 10% of the current produced. It was calculated that the investment costs and the current consumption could be reduced significantly by additional development work. A prototype of the nozzle stages proposed for the pilot plant is under construction. (tr-auth)

33337 ISOTOPIC SEPARATION PROCESS. Robieux, Jean; Auclair, Jean-Michel (to Compagnie Generale d'Electricite). U. S. Patent 3,443,087. May 6, 1969. Priority date Oct. 21, 1963, France.

A method for separating isotopes of a gaseous mixture containing an isotope having a first excitation energy level and an isotope having an excitation energy level higher than the first is described. The method consists of subjecting the gaseous mixture to radiation emitted by a radiation source at a predetermined frequency that excites the molecules of the first isotope but not those of the second isotope. The gaseous mixture is subjected to radiation emitted by a second radiation source at a predetermined frequency which ionizes the excited molecules of the first isotope but not the nonexcited molecules of the second isotope. The gaseous mixture is exposed to a field which selectively deflects the ionized molecules in the mixture, and separates the ionized molecules from the nonionized molecules. (Offic. Gaz.)

33338 DEVICE FOR THE SEPARATION OF RADIOACTIVE ELEMENTS. (to Societe Saint-Gobain Techniques Novelles). French Patent 1,432,721. Filed Feb. 10, 1965.

A device for the separation of a short-lived radioactive daughter element, e.g., ^{137}Ba, from its long-lived parent element, e.g., ^{137}Cs is described. The device is comprised of a tubular vessel containing an ion exchange resin on which the parent element is fixed. The vessel is closed at both ends with fritted filter plates and provided at its bottom with a hypodermic needle. There is a second tubular vessel containing an ion exchange resin and closed at its upper end with a plug to be pierced by the hypodermic needle. A pump is used for introducing an eluting agent from a storage-vessel into the top of the first vessel. A bacteriological filter is connected to the outlet of the second vessel and is provided at its bottom with a hypodermic needle. An elutrient collecting vessel is provided which is closed by a rubber plug and is pierced by the second hypodermic needle. The vessels are mounted in a tubular protective casing which is easily detachable from the device allowing the vessels to be replaced without direct handling. A biological lead shield is included. (NPO)

33339 PROTECTIVE ENCLOSURE AND MOUNT FOR RADIOACTIVE ELEMENTS. Smith, Theodore M. U. S. Patent 3,449,575. June 10, 1969. Filed Sept. 23, 1965.

A protective enclosure and mounting for radioactive elements are described. A split removable metallic ring impregnated with radioactive material is nested within an annular groove of a metal support band. A metallic window band is mounted over the support band and encloses the ring. Annular retainers with outer radial

flanges are spaced opposite each other. These are mounted and sealed over the window and support bands. (Offic. Gaz.)

33340 COMPARISON OF THREE SEPARATION METHODS. Becker, E. W. (Karlsruhe Univ., Ger.). Nucl. News, 12: No. 7, 46-51(July 1969).

With the advent of additional nuclear reactors in the next ten years, the requirements of uranium-235 will increase such that existing separation plants will be unable to produce sufficient fuels. The gas diffusion and gas centrifuge processes are now operating. Another method of enriching uranium-235 has been developed which is based on the partial spatial demixing of components of different weights in a gas flowing along curved tracks. Known as the separation nozzle method, it avoids the fine porous membranes of the diffusion method and the mechanically highly stressed components of the centrifuge. The 3 methods are described, and compared economically and technically. (J.C.W.)

Materials Testing

Refer also to abstracts 33329, 33951, 34083, and 34695.

33341 (CONF-690609-10) QUALITY ASSURANCE PROGRAM FOR THE MONTICELLO FIELD-FABRICATED REACTOR VESSEL. Varnum, Edward E. (Chicago Bridge and Iron Co., Oak Brook, Ill.); Jokela, William V. (Northern States Power Co. [Minneapolis, Minn.]). June 9, 1969. 15p. Dep. CFSTI.

From 15th Annual Meeting of the American Nuclear Society, Seattle, Wash.

The quality assurance program used in the field fabrication of the pressure vessel for the Monticello Power Reactor is discussed. The effects of careful advance planning, adherence to procedures, and careful supervision on the quality of the vessel, are stressed. (F.S.)

33342 IMAGING WITH NEUTRONS. Haskins, Jerry (Vallecitos Nuclear Center, Pleasanton, Calif.). Ind. Res., 11: No. 7, 40-3(July 1969).

X-ray and neutron radiography are compared. A brief history of the development of neutron radiography is given. Future uses for neutrography are described and neutron sources applicable to this method of nondestructive testing are discussed. (F.S.)

33343 APPLICATION OF METHODS USING PULSED ELECTRO-MAGNETIC FIELDS TO THE NON-DESTRUCTIVE TESTING OF LIQUID-METAL FAST-REACTORS. Renken, C. J. (Argonne National Lab., Ill.). Bull. Inform. Sci. Tech. (Paris), No. 136, 15-26(Apr. 1969). (In French).

A method and its application for nondestructive testing using pulsed-field eddy currents is described. The method is used to check the fuel element cladding tubes of a fast neutron reactor; and to detect faulty bondings between the fuel elements and the capsules, these bondings being made through liquid sodium. (auth)

33344 DESCRIPTION OF A TESTING APPARATUS MAKING USE OF EDDY CURRENTS, CFS 67 FIRST RESULTS. Destribats, M. T. (CEN, Saclay, France); Pigeon, M.; Desclee, B. Bull. Inform. Sci. Tech. (Paris), No. 136, 27-34(Apr. 1969). (In French).

In an effort to improve reliability, increasingly necessary in the nuclear field, a test method making use of eddy currents was developed at the same time as the ultrasonic method, which requires a coupling liquid. Research was also devoted to automation and the visual display of defects. An original apparatus is described with which cladding can be analyzed by means of sinusoidal signals. Its frequency can be varied continuously from 300 Hz to 300 kHz. The results obtained with this apparatus on several types of stainless steel, magnesium and beryllium cladding are presented. (auth)

33345 COMPOSITIONAL EXAMINATION OF LITHIA GLASSES BY NEUTRON-INDUCED AUTORADIOGRAPHY. Wood, F. W.; Robinson, A. H. (Oregon State Univ., Corvallis). Mater. Sci. Eng., 4: 247-8(July 1969).

An autoradiographic method of measuring distributions of atoms at surfaces where diffusion, segregation, phase separation, deposition, corrosion or similar events have occurred is described. The method is based on alpha particle ejection from certain light element isotopes caused by the capture of thermal neutrons. Basic conditions applicable to lithia-silica glasses are given. A TRIGA III reactor provided irradiations of 10^{11} to 5×10^{11} neutrons/cm^2. Alpha tracks were detected using a plastic of nitrocellulose containing synthetic camphor as a solvent and traces of alcohol as a secondary solvent. (F.S.)

33346 DEVELOPMENT OF NEUTRON RADIOGRAPHY WITHIN THE CEA. Boutaine, J. L. (CEN, Saclay, France). Bull. Inform. Sci. Tech. (Paris), No. 136, 35-44(Apr. 1969). (In French).

In the swimming pool reactors at the Cadarache, Grenoble and Saclay Centers, neutron radiographic devices, using the principle of the immersed conical collimator, provide satisfactory means of examining the various systems designed for studying the different fuels and structural materials used in nuclear technology. The advantages and disadvantages of the neutron radiography method are described and some examples of their present-day practical use in nuclear technology are given as well as some suggestions for their use outside the nuclear field. The first results of research on the possibilities of using neutron generators and radioisotopic sources are described. (auth)

33347 PROCEEDINGS OF THE FIFTH INTERNATIONAL CONFERENCE ON NONDESTRUCTIVE TESTING, [HELD AT MONTREAL, CANADA, MAY 21-26, 1967]. Ottawa, The Queen's Printer, 1969. 507p. $30.00. (In English and French). (CONF-670505).

Eighty-three papers were presented at the conference. A separate abstract was prepared for 14 of the papers. The remaining papers covered information on eddy current, magnetic, radiography, thermal, ultrasonic, and x radiation testing not within scope of NSA. (R.C.K.)

For abstracts of individual papers see: 33348-33361.

33348 TELEVISION SYSTEMS FOR NONDESTRUCTIVE TESTING. Berger, Harold (Argonne National Lab., Ill.). pp 118-25 of Proceedings of the Fifth International Conference on Nondestructive Testing. Ottawa, The Queen's Printer, 1969.

From 5th International Conference on Nondestructive Testing, Montreal, Canada. See CONF-670505.

The methods of operation of a number of unusual television techniques are discussed, as are the capabilities of each system in regard to sensitivity, resolution, contrast, and speed of response. Emphasis is placed on those television techniques which respond to x-radiation, infrared, ultrasound, and neutrons; ultraviolet and light sensitive television systems also receive some attention. In addition to the discussion of each system, the general areas of application of television systems for nondestructive testing are outlined. Included is a discussion of the advantages and limitations of television techniques as applied to the nondestructive testing area. Several methods for recording and using test data from such television systems are given. An extensive bibliography is included. (auth)

33349 THERMOLUMINESCENT IMAGE-DETECTION METHOD FOR NEUTRON RADIOGRAPHY. Kastner, Jacob; Berger, Harold; Kraska, I. R. (Argonne National Lab., Ill.). pp 132-4 of Proceedings of the Fifth International Conference on Nondestructive Testing. Ottawa, The Queen's Printer, 1969.

From 5th International Conference on Nondestructive Testing, Montreal, Canada. See CONF-670505.

A thermoluminescent method for displaying thermal-neutron images is described. A sheet of ^{6}LiF, exposed to the imaging neutrons for periods as long as is necessary to capture the image, can be made to reproduce the image by means of the light emission produced by heating at any time after the exposure. The excellent storage capability of this detection method makes it attractive for use with relatively low-intensity neutron radiographic beams. Images can be obtained for total thermal neutron exposures of about 10^9 n/cm^2. A high-contrast resolution capability of about 0.125 mm and a contrast sensitivity of about 10% have been demonstrated. (auth)

33350 APPLICATION OF THE LASER-BEAM TECHNIQUE IN MECHANICAL TESTING OF HIGH-TEMPERATURE MATERIALS. Axelrad, D. R. (McGill Univ., Montreal). pp 169-73 of Proceedings of the Fifth International Conference on Nondestructive Testing. Ottawa, The Queen's Printer, 1969.

From 5th International Conference on Nondestructive Testing, Montreal, Canada. See CONF-670505.

The arrangement of a mechanical test apparatus for testing high-temperature materials such as BN, Si_3N_4, SiC, WoC, etc. using a laser beam technique is described. An intense light beam is generated by means of a solid-state ruby laser (Al_2O_3 with 0.04% Cr_2O_3) which permits a fast local temperature rise of the test-piece of up to 400°C above a steady-state temperature. The latter can be chosen within the range of 0 to 1600°C. The test equipment consists of a high-temperature furnace and control circuit, the laser device including the power supply and control unit, and electronic strain measuring devices for the measurement of longitudinal and transverse deformation of the specimens

due to thermal shock. Some of the test results obtained by using this technique, as well as metallographic investigations of material specimens of "0-grade" tungsten carbide-cobalt compounds, are briefly discussed. (auth)

33351 IMPROVED RESOLUTION NEUTRON RADIOGRAPHY. Blanks, B. L.; Garret, D. A.; Morris, R. A. (Los Alamos Scientific Lab., N. Mex.). pp 242-7 of Proceedings of the Fifth International Conference on Nondestructive Testing. Ottawa, The Queen's Printer, 1969.

From 5th International Conference on Nondestructive Testing, Montreal, Canada. See CONF-670505.

Experiments in neutron radiography have demonstrated the feasibility of producing radiographs with image resolution comparable to that produced with x or γ radiation. Neutron collimation and imaging experiments are described in relation to the general problem of image unsharpness. Theoretical and experimental analyses of a neutron beam emergent from a simple collimating system are presented. Emphasis is placed on the angular divergence of the primary neutron beam and the resultant intensity pattern produced in the image plane. The theoretical analysis is shown to be basically correct for simple collimators and, in a qualitative manner, is applied to the more complex collimating systems employed in production neutron radiography. The results of production applications of neutron radiography at the Los Alamos Scientific Laboratory are described and include the detection of an O-ring in a nitrogen valve, the inspection of metallic-encapsulated high explosive components, and the detection of the boundary between different isotopic uranium compounds. (auth)

33352 APPLICATIONS OF NEUTRON RADIOGRAPHY USING A POOL REACTOR. Carbiener, Wayne A. (Battelle Memorial Inst., Columbus, Ohio). pp 247-50 of Proceedings of the Fifth International Conference on Nondestructive Testing. Ottawa, The Queen's Printer, 1969.

From 5th International Conference on Nondestructive Testing, Montreal, Canada. See CONF-670505.

The technique and apparatus used to obtain neutron radiographs of irradiated nuclear fuel specimens are described. The Battelle Research Reactor, a 2 MW pool reactor, is used as a neutron source and all specimen handling and foil activation phases are carried out completely underwater, thereby using the reactor as a biological shield. Radiographs of clad and encapsulated fuel samples have been obtained. These radiographs have shown fuel pellet interfaces, cracking, fuel relocation, and swelling. Representative radiographs are included. (auth)

33353 THE PRESENT ASPECTS OF NEUTRON RADIOGRAPHY IN TOSHIBA. Inouye, Tamon; Kawasaki, Shinsuke; Wakabayashi, Nobuyoshi; Ogawa, Kazuyuki (Tokyo Shibaura Electric Co. Ltd.). pp 250-4 of Proceedings of the Fifth International Conference on Nondestructive Testing. Ottawa, The Queen's Printer, 1969.

From 5th International Conference on Nondestructive Testing, Montreal, Canada. See CONF-670505.

Two beam ports of the 100-kW Toshiba Training Reactor are converted to two collimators for thermal neutron radiography having the neutron intensity of 2.5×10^5 n/cm^2-sec with a cadmium ratio of 3.5. Neutron radiographs are obtained by the image transfer method using an indium screen, and the direct method using a gadolinium screen which needs only 10 minutes to expose. One application of the image transfer method is to examine the nonirradiated and the highly irradiated nuclear fuels which cannot be done with x-ray radiography. This method is satisfactorily free from γ-ray fogging. The cadmium shadowing method, using cadmium compound solution by which it is possible to detect the hair cracks and a porous portion of the sample, suggests a number of application possibilities. Images obtained by thermal neutron radiography are analyzed by the technique of Fourier analysis. The optical transfer functions related to the unparallelism of thermal neutron beams in the process of image transfer from an activated indium screen to an x-ray film are derived, and compared with experimental procedures using a cadmium-made Siemens-star. (auth)

33354 NONDESTRUCTIVE CONTROL OF CANS OF PROTOTYPE FUEL ELEMENTS OF FAST NEUTRON REACTORS. Dufayet, J.-P.; Samoel, A.; Spriet, B. (CEN, Cadarache, France). pp 291-8 of Proceedings of the Fifth International Conference on Nondestructive Testing. Ottawa, The Queen's Printer, 1969. (In French).

From 5th International Conference on Nondestructive Testing, Montreal, Canada. See CONF-670505.

Methods for the destructive and nondestructive testing of fuel element cans were developed in order to improve the quality of the cans. These tests were useful in the selection of canning materials as a function of their mechanical properties at high temperatures. The testing methods were developed not only for the purpose of eliminating defective cans but also to advance the technology of fabrication in the sense of the homogeneity of different lots of tubes. The testing was done by metrology, eddy current, fluorescent penetrant, and internal pressure methods. The cans were fabricated of Type 316 stainless steel without solder. The criteria for the selection of the tubes to be tested were arbitrarily made. These criteria included measurement tolerances, eddy current amplitudes, fluorescent penetrant parameters, and the maximum permissible deformations in the tests under internal pressure. It was possible to show characteristic defects such as excessive wall thicknesses. Fabrication methods were modified as a result of the tests. It was found that each test method had its own field of applicability. The development of the ultrasonic testing method is anticipated to complement the eddy current method. (R.C.K.)

33355 ULTRASONIC TESTING OF SOLIDS AT ELEVATED TEMPERATURES. Lynnworth, Lawrence C.; Carnevale, Edmund H. (Panametrics, Inc., Waltham, Mass.). pp 300-7 of Proceedings of the Fifth International Conference on Nondestructive Testing. Ottawa, The Queen's Printer, 1969.

From 5th International Conference on Nondestructive Testing, Montreal, Canada. See CONF-670505.

High-temperature ultrasonic tests are required to measure and control materials early in processing. Illustrative examples at temperatures above 1000°K include thickness and temperature measurements in continuous casting of steel, and "pipe" detection to guide steel billet cropping. Laboratory studies up to 2800°K have demonstrated the feasibility of applying ultrasonics to these nondestructive testing problems. Longitudinal and shear waves are momentarily coupled at high pressure to bulk specimens. It is shown that shear waves offer some unique advantages over longitudinal waves, and that sometimes both waves are required to characterize a material ultrasonically. Techniques are described for measuring average temperature and temperature distribution within a solid along a chosen path by exploiting the temperature dependence of longitudinal wave velocity, shear wave velocity, and/or Poisson's ratio. In addition to the above nondestructive testing applications, high-temperature ultrasonic tests provide information on basic physical properties of solids. Using the Pana-Therm, thin refractory wires have been ultrasonically tested beyond 3000°K. Results are presented for Mo and Re. (auth)

33356 NONDESTRUCTIVE DETECTION OF CONTENTS, RADIATION LEAKAGE, AND SOURCES IN CONTAINERS PACKED FOR TRANSPORTATION. Domanus, Jozef. pp 328-35 of Proceedings of the Fifth International Conference on Nondestructive Testing. Ottawa, The Queen's Printer, 1969.

From 5th International Conference on Nondestructive Testing, Montreal, Canada. See CONF-670505.

Nondestructive testing has been applied to the leakage of contents from packages by a radiometric method, and the leakage of radiation either by an autoradiographic or radiometric method to determine whether such packages have, during transportation, kept their containment and shielding properties. The containment vessel is assessed for leakage in a pressure tank by the air-bubble test, and if none are observed, the radioactivity of the water is measured. Admissible quantities of radioactivity in water have been determined by which it can be established whether the vessel is leaking. Testing for radiation leakage of lead containers involves the detection of defects in the radiation shielding. A radiation source placed in the packaging is used for this purpose. As radiation detectors either x-ray films (autoradiography) or a scintillation counter is used to scan the package (radiometry). To determine the sensitivity of both methods, test containers were used with artificial defects. A combination of characteristic film curves with lead attenuation curves, gave new curves from which defect depths could be read vs film-density increase. With the radiometric method a recording count-rate meter was used, calibrated against artificial defect depths. In both methods theoretical values gave higher readings, due to the influence of scattered radiation. Analysis of results permitted the establishment of new criteria of failure. (auth)

33357 EFFECTS OF THE SPECTRAL SENSITIVITY OF EMULSIONS AND OF THE SPECTRAL COMPOSITION OF IONIZING RADIATIONS IN THE QUALITY OF RADIOGRAPHIC IMAGES. Ruault, P. A. (Gaz de France, Paris). pp 365-72 of Proceedings of the Fifth International Conference on Nondestructive Testing. Ottawa, The Queen's Printer, 1969. (In French).

From 5th International Conference on Nondestructive Testing, Montreal, Canada. See CONF-670505.

Research on methods for nondestructive testing using x rays and gamma radiation is described. A plate of steel was used for the tests in which there were three neighboring parallel slits of about 30 μ size. The tests were conducted using an x-ray point source arranged to face one of the slits. A linear gamma source was used which was of sufficient length that a portion would face each of the slits. The tests showed that for each material there exists a cross section of well-defined thickness for which the spectral quality of the radiation will permit the best possible detection of a defect by making use of primary radiation of a given quality. This range of optimum thickness differs noticeably from that which was indicated by the equipment manufacturers, the values being much below those indicated by the operating instructions. It appeared to be preferable to carry out the radiography with radiation of relatively high energy. This makes it possible to avoid a secondary emission of which the average energy is in the spectral range where the emulsion has its greatest speed. (R.C.K.)

33358 RELATIONS BETWEEN RADIOGRAPHIC IMAGE QUALITY AND FILM DENSITY. Bock, W.; Mundry, E.; Schnitger, D. (Bundesanstalt fuer Materialpruefung, Berlin). pp 372-7 of Proceedings of the Fifth International Conference on Nondestructive Testing. Ottawa, The Queen's Printer, 1969.

From 5th International Conference on Nondestructive Testing, Montreal, Canada. See CONF-670505.

The problems of how to introduce density as a parameter into the Moeller and Weeber theory of image quality expressed by wire sensitivity when irradiating material with x- and gamma radiation; how the wire images are to be computed analytically and how the image quality finally depends on the density are discussed. The relation of the film gradation dependency on the density was examined. It was shown that within the range of $0.5 < S \leq 5.0$ the characteristic curves of almost all investigated fine-grain films can be described as exponential functions and that a linear relation exists between gradation and density; therefore the gradation could be replaced by the density itself. It was possible to compute for different densities the shape of contrast, which describes the wire image, and to determine theoretically the wire sensitivity as a function of density by comparison with the contrast threshold values of the human eye, which were also determined as a function of density. These values are compared with the experiments, the influence of brightness on image quality is discussed, and optimum film densities are stated. (auth)

33359 LAYER-RADIOGRAPHY WITH A BETATRON. Ishii, Yugoro; Kanno, Akira (Tokyo Inst. of Tech.). pp 378-82 of Proceedings of the Fifth International Conference on Nondestructive Testing. Ottawa, The Queen's Printer, 1969.

From 5th International Conference on Nondestructive Testing, Montreal, Canada. See CONF-670505.

Layer-radiography with a betatron was applied to thick steel weldments to determine locations and shapes of defects. The fixed radiation source method was applied to movable samples, and the tomographic method was applied to samples welded directly to the 3000-ton fatigue testing machine. The extent of fading in both methods was the same, and the sectioned layer width, with a 2% detectability of the wire type defect, was determined to be 6 mm in the layer-radiography of a 100-mm thick steel plate. Simultaneous four layer-radiography was applied with a 6-mm sectioning interval and four pairs of lead screens of 0.3 mm thickness. This method could detect almost all defects that could be detected by ordinary radiography. Slag inclusion, a crack model and a nozzle weld part model were investigated and the defect locations were determined with a precision of 1 mm. The cracks, which were inclined to the radiation direction within an angle of the rotation, were detected more easily by layer-radiography than by ordinary radiography. (auth)

33360 RADIOGRAPHY WITHIN THE ENERGY RANGE 100 kV TO 15 MeV WITH ORWOCOLOR FILMS. Richter, H. U.; Linke, D. (VEB Schwermaschinebau Karl Liebnecht, Magdeburg, Ger.). pp 383-9 of Proceedings of the Fifth International Conference on Nondestructive Testing. Ottawa, The Queen's Printer, 1969.

From 5th International Conference on Nondestructive Testing, Montreal, Canada. See CONF-670505.

Radiography with color films produces more information in the two additional parameters, hue and saturation, than does conventional black-and-white radiography. Among the many techniques possible to produce color radiographs the direct technique was more closely investigated with the use of conventional color films. The transformation of the radiant energy into visible colored light was accomplished by the aid of fluorescence screens. The color contrast was increased by second-stage colored light exposure during the development process. Detailed densitometric investigations have been made and are disclosed. From the changes in hue and saturation it is possible to determine changes in the thickness of radiographed material. Also determinable from the hue is the tendency (decrease or increase) of such a change. An optimum exposure is possible by using the screen combination Zn-Cd-S/Pb 0.15. Exposure diagrams for radiant energies ranging from 100 kV to 15 MeV are presented. Exposure time and wire sensitivity are more unfavorable with conventional color films than with black-and-white radiography. The advantages associated with the color radiography are summarized. (auth)

33361 FLAW DETECTION IN FINNED, THIN-WALLED TUBES. Gorskii, V. V.; Pronyakin, V. T.; Lovyakin, E. M.; Zakharov, V. M. pp 410-12 of Proceedings of the Fifth International Conference on Nondestructive Testing. Ottawa, The Queen's Printer, 1969.

From 5th International Conference on Nondestructive Testing, Montreal, Canada. See CONF-670505.

Finned thin-walled tubes are used for canning reactor fuel rods. Helical fins on the outside surface of the tubes are made for spacing fuel rods in a subassembly. The canning tubes must be of very high quality to maintain the integrity of the fuel elements during reactor service. For ultrasonic testing of the finned tubes two types of apparatus and an eddy-current apparatus for measuring the wall thickness were made. For ultrasonic testing of the finned tubes we used Lamb waves. When the Lamb waves are propagated in the finned part of the wall it transforms and interacts with longitudinal and transverse sound waves which are reflected from the side surfaces of the fin. Thus, the total amplitude depends on the profile of the fin. The presence of the fins reduces the sensitivity of the ultrasonic inspection of the tubes and complicates the testing apparatus. The sensitivities of the two-probe ultrasonic method (through-transmission immersion technique) and the one-probe ultrasonic method (reflection immersion technique) for the detection of longitudinal defects in finned thin-walled tubes were studied. (auth)

33362 A NEUTRON RADIOGRAPHY UNIT BASED ON A (D,T) NEUTRON GENERATOR. Hendry, I. C. (Univ. of Stirling, Scotland). Int. J. Appl. Radiat. Isotop., 20: 423-8 (June 1969).

A description is given of the Dounreay (UKAEA) neutron radiography unit based on the use of a generator producing 10^{11} neutrons per second at 14 MeV. The available flux and shielding requirements are discussed and the main development problems highlighted. (auth)

Radioactive Material Handling

Refer also to abstracts 33261, 33305, 33315, and 33356.

33363 (AAEC/PM-2(Rev.)) NUCLEAR MATERIALS MANAGEMENT PROCEDURE. Hespe, E. D.; Moulding, A. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr. 1969. 49p. Dep.

Procedures are given for the management of nuclear materials. The accounting system, its structure, and responsibilities of the officers are described. Receipts, transport responsibilities, losses, nuclear production, disposals, security, storage, provisioning, purchasing, and selling are discussed. (J.C.W.)

33364 (CEA-R-3635(1)) SOIL CONTAMINATION. PART 1. CHANGES IN THE HUMIDITY OF NONSATURATED SOILS AFTER REJECT IN A LIMITED SPACE. Rancon, Daniel (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Feb. 1969. 52p. (In French). Dep.

An important feature in radiological safety studies of sites is the knowledge of water movements in the unsaturated layer surmounting the aquifer. This zone of aerated soil can be effective as a protection against aquifer contamination. Utilizing a neutron moisture meter, a method was developed to present graphically the water content of soil and the moistened volume evolution with time in the case of a limited infiltration surface. It is also possible to measure moisture gradients, drying kinetics, the retention capacity of soil, and the water content achieved by a given water head. The initial aqueous state effects the infiltration rate and not the moistened front position or the volume of moistened soil; consequently, the amount of storable water in the soil can be calculated. When water infiltration was stopped, the volume of moistened soil increased to an equilibrium state restricted by the moistened front and all the other water movements

occurred exclusively inside this volume. In case of radioactive waste disposal, the ionic pollution will be confined inside a measurable volume, the moistened front being the maximum limits of this volume. (auth)

33365 (CEA-R-3743) STUDY OF RADIOACTIVITY DIFFUSION FOR BITUMEN-COATED BLOCKS PRODUCED BY AN INDUSTRIAL COATING PLANT. Rodier, Jean; Lefillatre, Guy (Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule). Apr. 1969. 21p. (In French). Dep.

The solidification by bitumen of chemical coprecipitation sludges from the Marcoule waste treatment station was studied in the laboratory and led to the construction of an industrial coating plant. The quality of the coated material obtained was controlled by lixiviation tests carried out with ordinary water and seawater on 45 ml laboratory samples and on industrial coated blocks of 150 liters. Tests on blocks of such a size necessitated the installation of three special tanks. Two, each of 2,000 liters capacity, contain ordinary and seawater which was continuously recycled at a rate of 2.5 cm/hr and renewed periodically. In the third tank having a capacity of 11,000 liters, the coated block was buried in earth and sprinkled with ordinary water with a view to studying the migration of radioisotopes in soil. The results of these tests confirm those obtained during the laboratory experiments. (auth)

33366 (ORNL-TM-2591) SIMPLE METHOD FOR DETERMINING A COMBINED LEAD-STEEL SHIELD FOR SHIPPING CASKS THAT IS EQUIVALENT TO A LEAD SHIELD. Solomito, M.; Claiborne, H. C. (Oak Ridge National Lab., Tenn.). May 29, 1969. 11p. Dep. CFSTI.

A simple method is described for determining the combined steel-lead shield thickness of casks for shipping spent fuel elements when the required lead-shield thickness is known. Curves are given which relate the shielding provided by lead alone to an equivalent shield of lead followed by steel. This allows the designer to take into account quickly and simply the shielding effect of the structural steel which is normally used in shipping cask design. (auth)

33367 RADIOACTIVE WASTE REMOVAL METHOD. Hall, W. C.; Barker II, T. R. (to United States Atomic Energy Commission). U. S. Patent 3,448,859. June 10, 1969.

A method is given for preparing a closed package of solid, low-level, radioactive waste for shipment. A reusable shipping cask is loaded from a closed system with a liquid-solid mixture of radioactive waste. The solids from the mixture are screened in the cask, partially to fill the cask. The screened solids are dried with a desiccant that fills the cask by underlaying and overlaying the screened solids at the center of the cask. (AEC)

33368 DISPOSAL OF RADIOACTIVE WASTES INTO DEEP GEOLOGICAL FORMATIONS. Krause, H. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). At. Energy Rev., 7: No. 1, 47-70(1969).

With the continuous development of nuclear technology, the need for the ultimate disposal of radioactive wastes into deep underground storage sites is increasingly important, because this procedure can be applied on a large scale and completely excludes from the biosphere the radionuclides contained in the waste. According to the quality and activity of the wastes and the local geological conditions different methods can be used. Low- and intermediate-level effluents can be introduced under pressure into deep underground porous or fissured formations to the extent that these are completely isolated by impermeable strata from the water horizons that play their part in the biocycle. This method has been applied for some years quite successfully in the United States of America and the Soviet Union. If cleavable rock formations, especially shales, are available, radioactive liquids can be introduced into these under high pressure after having been mixed with cement and other aggregates. In this process, cleavages and fissures are formed along which the mixture can spread and in which it finally hardens. The fixation of radionuclides by cement and aggregates and the necessary insulation of the container rock from water-carrying strata guarantee the safety of the method. Solid rock is particularly suitable for storing solid waste. Since cavities in the rock are difficult to seal artificially, a natural insulation of the rock from groundwater by watertight strata is desirable. Radioactive liquids can be stored in caverns in rock only under particularly favourable geological conditions. In practice, vaults formed in rocks are used for storing low-level solid radioactive waste in Czechoslovakia and Spain. Up till now, no liquids have been disposed of in this way. Saline rock is particularly well suited to the storage of radioactive wastes of all kinds and classes of activity. The impermeability of saline rock to liquids safeguards absolute impermeability to the biosphere. The relatively good thermal conductivity of the salt even permits the storage of solid heat-generating wastes. Since saline rock of considerable depth exists in many countries and since it is possible to produce huge cavities in salt without any artificial support, this rock is excellently suited to the ultimate storage of radioactive wastes. Solid low- and intermediate-level wastes can simply be stacked in chambers of mines. High-level heat-generating wastes are best introduced into individual boreholes in the bottom of the chambers for better heat removal and covered with salt. Solid, liquid, and gaseous radioactive wastes can also be stored in caverns formed by solution mining. Comprehensive laboratory and field tests have been carried out, especially in the United States of America and the Federal Republic of Germany, with respect to the ultimate storage of radioactive wastes in salt. In the Federal Republic the first low-level wastes have already been introduced into a disused salt mine. (auth)

33369 IRRADIATED FUEL TRANSPORT FROM GARIGLIANO TO WINDSCALE. Kavanagh, M. T. (United Kingdom Atomic Energy Authority, Risley, Eng.). Nucl. Eng. Int., 14: 504-6(June 1969).

The transport of irradiated fuel elements from the Italian Garigliano and Latina power stations by M. V. Stream Fisher to Windscale works for reprocessing is described in terms of regulation requirements, design and approval of casks, venting considerations, and shipping arrangements. Emergency procedures are discussed. (UK)

Vacuum Engineering

Refer also to abstracts 33570, 33965, and 34696.

33370 EFFECT OF ULTRAHIGH VACUUM ON THE FRICTION BETWEEN METALS AND GRANULAR SOILS. Karafiath, Leslie L.; Mohr, George (Grumman Aircraft Engineering Corp., Bethpage, N. Y.). J. Vac. Sci. Technol., 6: 198-201(Jan.-Feb. 1969).

From 15th National Vacuum Symposium, Pittsburgh, Pa. See CONF-681012.

An apparatus was developed to measure the friction between metals and granular materials in ultrahigh vacuum. Pressures below $p = 10^{-9}$ torr have been routinely reached with the vacuum system consisting of a turbomolecular, a getter-ion, and a liquid-N_2-cooled titanium sublimation pump. The frictional resistance between steel and ground basalt in two particle size ranges was measured under various normal loads. The experiments showed that the ultrahigh vacuum did not affect the coefficient of friction significantly, but increased the frictional resistance by an adhesion ranging from 6 to 24 g/cm^2 for the various materials and conditions. (auth)

33371 STICKING PROBABILITY OF ATOMIC HYDROGEN ON GRAPHITE. Beitel, George A. (Univ. of Wisconsin, Madison). J. Vac. Sci. Technol., 6: 224-8(Jan.-Feb. 1969).

From 15th National Vacuum Symposium, Pittsburgh, Pa. See CONF-681012.

Standard ultrahigh vacuum and flash filament techniques were used to measure the sticking probabilities of atomic and molecular hydrogen S_H and S_m, respectively, on graphite. Atomic hydrogen was produced by a hot tungsten filament. Graphite samples were specially fabricated ribbons which could be flashed to 2500°K. The quantity of atomic hydrogen sorbed was found to be only dependent on the temperature of the graphite and the total number of incident hydrogen atoms. Thus it is possible to use a graphite ribbon as an atomic hydrogen detector. (auth)

33372 ADSORPTION OF NITROGEN, HYDROGEN, OXYGEN, AND CARBON MONOXIDE ON A BERYLLIUM FILM. Hurd, J. T.; Adams, R. O. (Dow Chemical Co., Golden, Colo.). Contract AT(29-1)-1106. J. Vac. Sci. Technol., 6: 229-33(Jan.-Feb. 1969).

From 15th National Vacuum Symposium, Pittsburgh, Pa. See CONF-681012.

Results of measurements of sticking coefficients of nitrogen, hydrogen, oxygen, and carbon monoxide on beryllium thick films at room temperature are described. Beryllium was vapor deposited onto glass substrates and the sticking coefficient of the impinging gas molecules was measured as a function of quantity adsorbed. No adsorption was observed with either nitrogen or hydrogen. A sticking coefficient of 0.4 for oxygen was measured with a total coverage of 8.4×10^{14} molecules/cm^2. Carbon monoxide displayed some pressure dependence and the initial sticking coefficient was found to be roughly proportional to the square root of the pressure. In the 10^{-6} torr range a sticking coefficient

of 0.1 was measured with a total coverage of 4.0×10^{13} molecules/cm^2; in the 10^{-7} torr range a sticking coefficient of 0.5 was measured with a total coverage of 2.4×10^{14} molecules/cm^2. (auth)

33373 ELECTROSTATIC CHARGE DISTRIBUTION ON ULTRAHIGH VACUUM CLEAVED SILICATES. Grossman, J. J. (McDonnell Douglas Astronautics Co., Santa Monica, Calif.). J. Vac. Sci. Technol., 6: 233-6(Jan.-Feb. 1969).

From 15th National Vacuum Symposium, Pittsburgh, Pa. See CONF-681012.

Recent measurements of relatively strong long-range electrostatic attractive forces, produced by ultrahigh vacuum cleavage of silicates, prompted the design and fabrication of a special UHV system to measure the charge distributions. The system is described in this paper, together with preliminary results from the experiment. Charge distributions found to date have varied from dipolar to octapolar shapes on the face of cylindrical samples in excess of 1 esu/cm^2. A relationship appears to exist between the orientation of the multipolar distributions and the crystallographic axes. Results from the first cleavages of orthoclase (nominally, $KAlSi_3O_8$) at 10^{-10} torr indicate that there are at least two discharging mechanisms: first, the charge decays to one half its initial (extrapolated to zero) value in 1.5 h due to gas adsorption; second, it then decays very slowly with a half-life of at least 76 days. Irradiation with uv light causes discharge. When the pressure in the system is raised towards atmospheric with dry nitrogen, the charge is stable (to a first order of approximation) up to pressures in the 10-μ range. Discharge in bursts, as the pressure is raised, is readily explained by the Paschen sparking potential relation for gaseous discharges. (auth)

33374 INVERSE PRESSURE DEPENDENCE OF THE QUADRUPOLE IONIZATION GAUGE. Schwarz, Helmut; Tourtellotte, H. A. (Rensselaer Polytechnic Inst., East Windsor Hill, Conn.). J. Vac. Sci. Technol., 6: 260-2(Jan.-Feb. 1969).

From 15th National Vacuum Symposium, Pittsburgh, Pa. See CONF-681012.

A nonmagnetic ionization gage was developed in which electrons are oscillating back and forth along the axis of the tube as in a Penning-type ion gauge. The electrons are emitted from a hot hairpin filament at one side of a cylindrical tube and are accelerated by a dc potential of 27 V towards the other end. At the other end there is a disk-shaped electrode which has the same potential as the cathode. This causes the electrons to travel back and forth between the ends until they suffer a collision. A quadruple system serves to keep the electrons from reaching the electrodes and the wall. The system is excited by a rf oscillator of 200 MHz and 165 V peak voltage which is tuned in such a way that only electrons will not deviate from stable trajectories along the center of the tube. A closed screen surrounds the whole electrode structure. It is at a slightly negative potential and serves as the ion collector. Within the pressure range $p = 10^{-5}$ to 10^{-10} torr the ion current i follows the relationship $pi^n = c$. n was found to be 1.31 ± 0.02 for electron emissions of 10, 50, 100, and 500 μA. The constant c was $c = 2.88 \times 10^{-17}$ for 10 μA, 2.63×10^{-16} for 50 μA, and in the case of 100 μA it was 5.37×10^{-15}. (auth)

33375 ULTIMATE PRESSURE LIMITATIONS. Bills, D. G. (Granville-Phillips Co., Boulder, Colo.). J. Vac. Sci. Technol., 6: 166-73(Jan.-Feb. 1969).

From 15th National Vacuum Symposium, Pittsburgh, Pa. See CONF-681012.

Present limitations on attaining low pressures are examined in detail. Evidence for the existence of pumping mechanisms at very low pressures is reviewed and it is shown that the present difficulties in achieving pressures much below 10^{-12} torr in room temperature systems appear to be due to inadequate or improper processing of the system materials. Curves showing the partial pressure as a function of time and temperature for volume, surface, dissolved, and permeating gases in a typical system are given. It is concluded on the basis of present evidence that pressures in the 10^{-16} torr range should be routinely possible provided the entire system is designed and operated to minimize permeation and is carefully processed to remove dissolved gases. (auth)

33376 PREPARATION AND SUPERCONDUCTING PROPERTIES OF THIN FILMS OF TRANSITION METAL INTERSTITIAL COMPOUNDS. Gavaler, J. R.; Hulm, J. K.; Janocko, M. A.; Jones, C. K. (Westinghouse Research Labs., Pittsburgh). J. Vac. Sci. Technol., 6: 177-80(Jan.-Feb. 1969).

From 15th National Vacuum Symposium, Pittsburgh, Pa. See CONF-681012.

The importance of geometric parameters in determining the superconducting properties of a material has been a topic of considerable theoretical interest. Experimental investigation has been restricted principally to thin-film structures of the nontransition elements, compared to materials possessing relatively small superconducting non-parameters (K). Studies on thin-film structures of transition metal compounds having both high critical temperatures ($T_c \gtrsim 14$°K) and large upper critical fields ($H_{c2} \gtrsim 100$ kOe) have been performed. The materials have the rocksalt structure (B1) and are based upon the compound niobium nitride, NbN. The films were prepared by reactive sputtering in argon-nitrogen atmospheres in an ultrahigh vacuum system with a background pressure $\leq 5 \times 10^{-10}$ torr. Variation of the nitrogen partial pressure over the range 10^{-3} to 10^{-6} torr was used to obtain different film compositions. (auth)

33377 PROCEEDINGS OF THE FIFTEENTH NATIONAL VACUUM SYMPOSIUM OF THE AMERICAN VACUUM SOCIETY AND THE THIN-FILM SYMPOSIUM OF THE THIN-FILM DIVISION OF THE AMERICAN VACUUM SOCIETY, 28 OCTOBER–1 NOVEMBER 1968, PITTSBURGH, PENNSYLVANIA. Propst, F. M. (ed.). J. Vac. Sci. Technol., 6: 1-277(Jan.-Feb. 1969). (CONF-681012).

Sixty-six papers were presented at the conference. A separate abstract was prepared for each of 14 papers. The remaining 51 papers contain information on thin films, pumping techniques, mass analyzers, surface science, space science, pressure measurement, and various general topics not within scope of NSA. (R.C.K.)

For abstracts of individual papers see: 33370–33376, 33378–33380, 33569, 33570, 33965, and 34696.

33378 DIFFUSION OF NITROGEN THROUGH Zr–Al ALLOYS IN VACUUM. della Porta, P. (SAES Getters, Milan); Kindl, B.; Ruetsch, Ch.; Schoenhuber, M. J. J. Vac. Sci. Technol., 6: 40-4(Jan.-Feb. 1969).

From 15th National Vacuum Symposium, Pittsburgh, Pa. See CONF-681012.

Sorption of nitrogen by a Zr–Al alloy has been measured at constant temperatures at 300 and 500°C and for nitrogen pressures in the range 10^{-6} to 1 torr. The pumping speed of the Zr–Al alloy for nitrogen decreases as the nitrogen pressure is increased and increases with temperature. For a constant nitrogen pressure the pumping speed tends to decrease with time owing to increase in surface concentration. After sorption has been completed the pumping speed can be partially or entirely restored to its initial value by maintaining the active surface at the operating temperature under a low nitrogen partial pressure, e.g., 10^{-6} torr. During this recovery process nitrogen compounds at the surface migrate towards the interior of the Zr–Al alloy. The data obtained facilitate, at least qualitatively, the measurement of the diffusion of nitrogen from the surface to the bulk metal as a function of time at constant temperature. The data can also be used to predict the behavior of Zr–Al based getter pumps during and after high throughput applications. (auth)

33379 MAGNETRON-TYPE ION SOURCE FOR LOW-PRESSURE RESIDUAL GAS ANALYSIS. Davis, W. D. (General Electric Research and Development Center, Schenectady, N. Y.). J. Vac. Sci. Technol., 6: 85-8(Jan.-Feb. 1969).

From 15th National Vacuum Symposium, Pittsburgh, Pa. See CONF-681012.

A conventional electron bombardment ion source operating at 10 to 100 μA emission is difficult to outgas sufficiently to allow accurate analysis of the residual gas at pressures below 10^{-12} torr. In addition, the ions formed by electron bombardment of the surface may contribute specific mass peaks or a broad background of scattered ions to the mass spectrum. By using a magnetron-type ion source to increase the electron path, both these effects can be substantially reduced. The results obtained using this type ion source on a 5-cm radius magnetic sector instrument are described. Using an electron emission of 4×10^{-3} A, an ion current of 2×10^{-4} A/torr is obtained for N_2. The two major peaks at low pressure are H_2 (1.5×10^{-13} torr) and mass 28 (3×10^{-14} torr). No electronically desorbed ions have yet been observed and the background ion current is less than 10^{-17} torr. (auth)

33380 MASS SPECTROMETRIC INVESTIGATION OF THE ION DESORPTION IN UHV GAUGES. Huber, W. K.; Rettinghaus, G. (Balzers Aktiengesellschaft fuer Hochvakuumtechnik und Duenne Schichten, Balzers, Liechtenstein). J. Vac. Sci. Technol., 6: 89-92(Jan.-Feb. 1969).

From 15th National Vacuum Symposium, Pittsburgh, Pa. See CONF-681012.

Electron-induced ion desorption from platinum, platinum–iridium, and molybdenum is studied by means of a quadrupole

mass spectrometer, in order to determine its influence on the measurement of pressure by ionization gauges. Adsorbed species studied were H, H_2O, CO, and O_2. Ion yields, which were obtained under various conditions, are given. Interaction between coadsorbed species caused changes in the electronic desorption probabilities from the values observed for the separately adsorbed species. Suggestions are given for proper operation of ionization gauges in order to minimize ion desorption. (auth)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstract 34903.

33381 (AAEW-M-891) MONITORING OF GASEOUS EFFLUENTS FROM REACTORS. Johns, T. F. (Atomic Energy Establishment, Winfrith (England)). Apr. 1969. 6p. (CONF-690103-14). Dep. CFSTI.

From Health Physics Society Midyear Topical Symposium, Los Angeles, Calif.

Techniques developed and used at the Atomic Energy Establishment, Winfrith, for monitoring discharges of inert gases from reactor systems are described, as well as techniques used for continuously monitoring for small (millicurie) releases of iodine-131 in the presence of much larger quantities (hundreds of curies) of inert gases. Difficulties experienced in the use of these monitors are discussed, and brief mention is made of the technique used for measuring releases of tritiated water vapor. (auth)

33382 (ANL-7282, pp 188-209) PULSE-HEIGHT DEFECT DUE TO ELECTRON INTERACTION IN THE DEAD LAYERS OF Ge(Li) γ-RAY DETECTORS. Strauss, M. G.; Larsen, R. N. (Argonne National Lab., Ill.).

After a discussion of the pulse-shape distributions resulting from the interaction of gamma rays in a planar Ge(Li) detector, a pulse-shape discrimination system was described. The interaction of internal-conversion electrons in planar Ge(Li) detectors was also examined. The degradation of the gamma spectra as a result of electron interaction in the dead layers of Ge(Li) detectors was investigated. (B.G.D.)

33383 (CEA-CONF-1235) DEVELOPMENT IN THE FIELD OF NEUTRON DETECTORS. Bacconnet, Eugene; Comte, Raymond; Duchene, Jean (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 21, 1968. 25p. (In French). (CONF-680955-1). Dep.

From International Conference on Nuclear Electronics, Versailles, France.

Some aspects of the CEA development of neutron detectors of the conventional type such as proportional counters and fission chambers used for the control of reactors or for neutron physics experiments are reported. The fabrication, and performance of proton recoil counters and boron deposit counters are briefly described. Coaxial and triaxial cables were developed for use at high temperatures. The performance of these cables with respect to insulation resistance as a function of temperature, and pulse transmissions at room and high temperature was determined. The measurement of the linearity of a pulse device with fission chambers was described. (J.S.R.)

33384 (CEA-CONF-1262) POSSIBILITIES OFFERED BY THE GAS DETECTORS FOR THERMAL NEUTRONS FUNCTIONING IN A NONPROPORTIONAL REGION. Allemand, R.; Vacarie, J. P. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Apr. 8, 1968. 8p. (In French). (CONF-680302-10). Dep.

From International Symposium on Nuclear Electronics and Radioprotection, Toulouse, France.

Boron and BF_3 counters operating in the region of direct collection of charges are described and compared with classical proportional counters. Two experimental counters, one to measure the humidity and density of a glacier and the other a neutron diffraction counter, are described. The parameters affecting the characteristics of a boron or BF_3 detector are defined. (J.S.R.)

33385 (CEA-CONF-1263) CONCEPTION AND DESCRIPTION OF ELECTRONIC MATERIALS OF SURVEILLANCE AND DOSIMETRY IN RADIOPROTECTION. Cordelle, M.; Allemand, R. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). May 2, 1967. 15p. (In French). (CONF-680547-1). Dep.

From French Rumania Conference, Bucharest, Romania.

In radioprotection there is a great diversity of problems connected with the detection of particles and this has given rise to numerous devices; from the strictly electronic viewpoint however, these devices can be classified into two large categories: devices for control consoles and individual and portable devices and special devices. The mechanical and technological conception of devices for control consoles are summarized. The basic design of the different electronic functions of measurement, power supply, and signaling is illustrated. For illustration of the principles discussed, the radiation control console at the 300-MeV linear accelerator at Saclay is described. Two recently developed individual and special devices are described. The first is the DIPAL, an automatic portable dosimeter delivering a noise signal for a present irradiation dose. The other device, the CPBG, is designed to monitor the $\beta-\gamma$ contamination of footwear. (J.S.R.)

33386 (LA-4090) THE RADIATION INSTRUMENT CALIBRATION FACILITY AT THE LOS ALAMOS SCIENTIFIC LABORATORY. Davis, R. W.; Graves, E. R. (Los Alamos Scientific Lab., N. Mex.). Jan. 16, 1969. Contract W-7405-eng-36. 12p. Dep. CFSTI.

The radiation instrument calibration facility at the Los Alamos Scientific Laboratory consists of six vertical shielded tubes of which three contain ^{60}Co, one ^{226}Ra, and one ^{239}Pu-Be neutron sources, mounted on elevator mechanisms. The sixth tube is for experimental source use. The gamma sources, which range from 2 mCi to over 300 Ci, produce exposure rates of from 0.145 mR/h to 3391 R/h. Effective neutron fluxes of from 1.5 to 1250 mrem/h are available, depending upon the type of instrument being calibrated. Details of the construction and calibration of the facility and the methods used for calibration of radiation survey instruments are given. (auth)

33387 (RT/FI-(69)15) MONTE CARLO CALCULATION OF THE ENERGY LOSS SPECTRA FOR GAMMA RAYS IN CYLINDRICAL NaI(Tl) CRYSTAL. Giannini, M.; Oliva, P.; Ramorino, M. C. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1969. 72p. Dep.

A Monte Carlo calculation to determine the pulse height response on NaI(Tl) crystals to gamma rays is described. The calculation program is reliable for gamma-ray energies up to 20 MeV. An improvement for what concerns the electron slowing down and the bremsstrahlung treatment has been introduced. Comparisons are made with experimental data and other calculated results. (auth)

33388 (STI/PUB-193(Vol.1)) MEDICAL RADIOISOTOPE SCINTIGRAPHY. VOLUME I. Proceedings Series. Proceedings of a Symposium Held in Salzburg, 6-15 August 1968. (International Atomic Energy Agency, Vienna (Austria)). 1969. 874p. (In several languages). (CONF-680804-Vol. 1). IAEA: $20.00; Austrian Schillings 517,-; £8.6.8; F.Fr. 98,-; DM 80,-.

Separate abstracts were prepared for each of the 59 papers presented. (W.H.K.)

For abstracts of individual papers see: 33417-33470, 33618, 33722, 33723, 33771, and 33772.

33389 (WAPD-Trans-117) ACTIVATION OF FOILS IN A THERMAL NEUTRON FIELD. Meister, H. Translated for Bettis Atomic Power Lab., West Mifflin, Pa., from Z. Naturforsch., 13A: 738-40(1958). 6p. Dep. CFSTI.

The effect of internal scattering on the count rate of an activation foil for thermal neutron flux measurements is calculated and found to be very small. (W.H.K.)

33390 NEUTRON FLUX MEASURING DEVICE COMPRISING A DETECTOR SURROUNDED BY A DOUBLE-WALLED JACKET CONTAINING NEUTRON ABSORBING FLUID. Kinoshita, Takehiko; Yatsurugi, Tatsuo (to Nihon Genshiryoku Kenkyujo). U. S. Patent 3,444,374. May 13, 1969. Filed May 29, 1967.

A neutron flux measuring apparatus is described which consists of a gamma-compensated, parallel circular plate, boron trifluoride filled, ionization chamber type neutron detector. The detector is surrounded by a fluid-tight, double-walled jacket into which a neutron absorbing fluid is introduced. The fluid may be in liquid or gaseous form and the neutron absorbing substance in the fluid may be of varying concentrations. (Offic. Gaz.)

33391 DETERMINATION OF ERRORS DURING WORK WITH PULSED SOURCES OF RADIATION. Kotlyarov, V. T.; Ofengenden, R. G. (Inst. of Physics, Kiev). Prib. Tekh. Eksp., No. 2, 63-8(Mar.-Apr. 1969). (In Russian).

A method for determining the probability of losses in measurement systems for pulsed sources of radiation. The error associated with this method is examined. Pulsed radiation sources are widely used in experiments in nuclear physics e.g., cyclotrons, pulsed reactors, and neutron selectors. (tr-auth)

33392 EFFICIENCY OF RECORDING OF BETA-ACTIVE SOLUTIONS BY SCINTILLATION GRANULES. Ekkerman, V. M.; Solomonov, V. M.; Tsirlin, Yu. A.; Gel'fman, A. Ya.

(All-Union Scientific Research Inst. of Monocrystals, Kharkhov). Prib. Tekh. Eksp., No. 2, 58-60(Mar.-Apr. 1969). (In Russian).

Using plastic scintillation granules, the relation of the efficiency of recording certain beta-active isotopes was investigated with respect to the level of discrimination, energy, shapes of recorded beta spectra, diameter, thickness of the layer, and degree of optical transparency. Formulas were proposed. (tr-auth)

33393 RECORDING OF LOW-ENERGY PROTONS BY SCINTILLATION COUNTERS. Bondarenko, L. N.; Erozolimskii, V. G.; Zakharova, V. P. Prib. Tekh. Eksp., No. 2, 61-2(Mar.-Apr. 1969). (In Russian).

It was shown that with scintillators of NaI(Tl) and CsI(Tl) single crystals it was possible to record protons with energies above 5 and 15 keV, respectively, with an efficiency of ~1. The version of the counter with CsI(Tl) single crystals of ~70mm diameter and ~20 microns thick has an efficiency of ~80% for protons with energies above 15 keV. (tr-auth)

33394 CHAMBERS FOR WORK WITH SEMICONDUCTOR DETECTORS. Rodionov, Yu. F.; Naumov, I. V. Prib. Tekh. Eksp., No. 2, 51-3(Mar.-Apr. 1969). (In Russian).

The design characteristics of vacuum chambers used with semiconductor alpha spectrometers and in an apparatus for measuring alpha-gamma coincidences are described. Both apparatuses are used for the isotopic analysis of alpha emitters. Drawings of the chambers and photographs of the detector apparatuses are given. (tr-auth)

33395 ESTIMATION OF CROSS SECTIONS FOR THE RECORDING OF CHARGED PARTICLES BY TELESCOPE COUNTERS. Slovokhotov, L. I. Tr. Fiz. Inst., Akad. Nauk SSSR, 45: 25-67(1969). (In Russian).

An algorithm is considered for calculating the differential cross sections of two-body reactions including the calculation of ionization losses and the rescattering of the recorded particle in the target and the detecting system. The solution is reduced to the calculation of iterated integrals with a degree of multiplicity, ≥8, which requires the use of the method of statistical tests. The algorithm is described for an approximate solution and its realization in the program for the M-20 computer. (tr-auth)

33396 EFFICIENCY CALIBRATION OF A Ge(Li) DETECTOR. Ishaq, A. F. M.; Khan, H. A.; Najam, M. R.; Khan, Z. U.; Qazi, M. N.; Ahmad, A. A. Z.; Ahmed, N. M. (Pakistan Inst. of Nuclear Science and Technology, Nilore). J. Natur. Sci. Math., 8: 165-9(Oct. 1968).

Attention is called to the usefulness of the well-established beta–gamma coincidence technique for low-energy efficiency calibration of Ge(Li) detectors. Results of the high-energy efficiency calibration using neutron capture gamma rays are also presented. (auth)

33397 MOESSBAUER SPECTROMETER BASED ON THE AI-256 ANALYZER. Veits, B. N.; Lisin, Yu. D. Prib. Tekh. Eksp., No. 2, 28-33(Mar.-Apr. 1969). (In Russian).

A Moessbauer spectrometer with constant source acceleration relative to the absorber and based on the AI-256 analyzer, used in the region of time analysis, is described. Details are given of the apparatus, using the total number of the channels in the analyzer for recording the spectrum, corresponding to the rates chosen as the reference signal. (tr-auth)

33398 FAST NEUTRON SPECTRUM MEASUREMENT IN HIGH GAMMA FLUXES USING NUCLEAR EMULSIONS. Bishop, G. B.; Saha, J. K. (Univ. of Liverpool). J. Nucl. Energy, 22: 487-95(Aug. 1968).

By adding 4g/l of a de-fogging agent (1-phenyl-5-mercaptotetrazole) to the developing solution, it was possible to scan proton tracks in an emulsion subjected to 8 Rad total γ-dose. Using this procedure the fast neutron spectrum within the core of the Universities Research Reactor was measured with Ilford L-series nuclear emulsions. (UK)

33399 NEW DETECTORS FOR HIGH-ENERGY PHYSICS. Hofstadter, Robert (Stanford Univ., Calif.). Science, 164: 1471-82(June 27, 1969).

A brief review of the historical development of the total absorption technique for detection of high-energy particles and gamma radiation is presented. The design and performance characteristics of total absorption shower cascade (TASC) detectors for electromagnetic interacting particles and total absorption nuclear cascade (TANC) detectors for strong interacting particles are discussed. (B.G.D.)

33400 TRITIUM COUNTING WITH THE TRITON X-100 SCINTILLANT. Turner, J. C. (Radiochemical Centre, Amersham, Eng.). Int. J. Appl. Radiat. Isotop., 20: 499-505(July 1969).

Toluene/Triton X-100 liquid scintillant was further investigated with regard to its counting characteristics for tritiated water. An improved simple method of sample preparation is described. The channels ratio method of determining counting efficiency was examined in detail for this system and can be satisfactorily applied over a fairly wide range of aqueous sample content. Triton X-100/P.P.O/P.O.P.O.P. containing no toluene was found to act as a liquid scintillant. A hypothesis is advanced to explain the mechanism of action of Triton X-100 in counting systems. (auth) (UK)

33401 APPARATUS FOR STORING ELECTRICAL PULSES. Laviron, Edouard (to Commissariat a l'Energie Atomique). British Patent 1,153,822. May 29, 1969. Priority date Sept. 1, 1965, France.

A recorder system for storing electrical pulses at a repetition rate of up to 10 ns from a scintillation detector is described. (W.H.K.)

33402 LIGHT GUIDE AND RADIATION SHIELD. (to Kewanee Oil Co.). British Patent 1,153,516. May 29, 1969. Priority date Mar. 10, 1966, United States.

A cadmium fluoride crystal which acts as a light guide and a radiation shield between a scintillation crystal and photomultiplier tube is described. This light guide transmits essentially all light radiations and absorbs all high energy nuclear radiations. (W.H.K.)

33403 DEVELOPMENT OF MULTIWIRE PROPORTIONAL CHAMBERS. Charpak, G. CERN Cour., 6: 174-6(June 1969).

The operation of multiwire proportional chambers is briefly outlined and properties are discussed including pulse height, use for detecting simultaneous particles, resolution time, localization, energy measurement, multiple coordinates, use as a hodoscope, and counting rate. Characteristics of multiwire proportional chambers are compared with characteristics of a scintillation hodoscope and a wire spark chamber. (W.H.K.)

33404 GATED CHARGE SENSITIVE PREAMPLIFIER. East, L. V. (Los Alamos Scientific Lab., N. Mex.). Nucl. Instrum. Methods, 71: 328-32(1969).

A charge sensitive preamplifier incorporating an internal linear gate is described. The preamplifier was developed for use with proportional counters subjected to accelerator beam pulses. Many features are incorporated that make it generally useful for other applications requiring a stable, moderately low-noise gatable preamplifier. Detector arrays with total input capacitance of greater than 10^3 pF may be used with minimal loss in preamplifier charge sensitivity. (auth)

33405 PARTICLE–GAMMA RAY CORRELATION APPARATUS. Zurmuehle, R. W.; Hinrichsen, P. F.; Fou, C. M.; Gould, C. R.; Anastassiou, G. P. (Univ. of Pennsylvania, Philadelphia). Nucl. Instrum. Methods, 71: 311-16(1969).

An angular correlation apparatus is described in which particles are detected at zero degree with respect to the incident beam by a position sensitive surface barrier detector located at the focal point of a magnetic spectrometer. Four 7.6 cm × 10.2 cm NaI(Tl) crystals are simultaneously used to detect coincident γ-rays at angles between 60 and 160°. Details of precautions taken to reduce γ-ray and particle backgrounds are given. Data are accumulated in three parameter mode using a computer-analyzer system. (auth)

33406 VERSATILE AND RELIABLE PROGRAMMING SYSTEM APPLIED TO AUTOMATIC DIRECTIONAL CORRELATION MEASUREMENTS. Gunnerhed, M. (Univ. of Stockholm). Nucl. Instrum. Methods, 71: 297-300(1969).

A versatile and reliable automatic programming system for the control of mechanical motion is described. The system can be extended to any number of freely chosen preset positions with individually variable statistical weight factors. (auth)

33407 EFFICIENCY CALIBRATION OF A Ge(Li) DETECTOR FROM 8 TO 98 keV. Slivinsky, V. W.; Ebert, P. J. (Univ. of California, Livermore). Nucl. Instrum. Methods, 71: 346-8(1969).

The efficiency of a Ge(Li) detector was measured using x-ray machines in the energy region from 8 to 98 keV by comparing the number of fluorescent x-rays counted by the Ge(Li) spectrometer with that by a totally absorbing NaI(Tl) spectrometer. The escape peak-to-photopeak ratios as measured are roughly 35% higher

than those of other published results. Monte Carlo calculations of the detector efficiency and escape fraction at different photon energies compare favorably with experimental data; these should be useful for other workers using a highly collimated Ge(Li) detector, which approximates semi-infinite geometry. (auth)

33408 NUCLEAR ELECTRONICS: THE CHARGE-SENSITIVE PREAMPLIFIER FOR SEMICONDUCTOR DETECTORS. Stanek, F. W. (Oskar-von-Miller-Polytechnikum, Munich). Kerntechnik, 11: 286-93(May 1969). (In German and English).

The function of a charge-sensitive preamplifier in radiation energy measurements is to convert the charge of the electric pulse signals from the detector into amplitudes of the voltage pulses used by the subsequent apparatus of the measuring channel. The transient response is calculated from the nodal equations established for a schematic block diagram. Inequalities are given defining the conditions required for the charge/voltage conversion. The attainable energy resolution is limited by noise and by the pile-up of signals, this latter phenomenon being due to the random distribution of the signals. Possibilities for improving the energy resolution are discussed. An example of dimensioning is given for which the sensitivity is calculated numerically. (auth)

33409 DETERMINATION OF THE FANO FACTOR IN GERMANIUM AT 77°K. Sher, A. H.; Pate, B. D. (Simon Fraser Univ., Burnaby, Can.). Nucl. Instrum. Methods, 71: 251-5 (1969).

The Fano factor in germanium at liquid nitrogen temperature has been determined through the observed line widths in pulse-height spectra from Ge(Li) detectors upon which gamma rays were incident with energies of 122, 356, 1173, and 1333 keV. Instrumental contributions to the line width were measured with a pulse generator and corrected for; the variation of charge collection with applied bias was determined and Fano factor measurements were made in a region where 100% collection efficiency was evidently obtained. A value for the Fano factor of 0.132 ± 0.008 has been obtained for the energy range studied. (auth)

33410 SOLID STATE DETECTOR FOR CHARGED PARTICLES AT RELATIVISTIC ENERGIES. Bateman, J. E. (Glasgow Univ.). Nucl. Instrum. Methods, 71: 256-60(1969).

Experiments are described in which a totally depleted silicon surface-barrier detector is used to detect the passage of fast electrons (1.5 to 2.3 MeV and 150 MeV). A good signal to noise ratio is obtained and the output pulses have rise times of 7 ns and adequate amplitude to drive tunnel diode logic circuits directly. The advantages of the detector over the photomultiplier-scintillator detector are discussed in relation to applications in high-energy physics. (auth)

33411 THE WALL EFFECT IN ^{3}He COUNTERS. Shalev, S.; Fishelson, Z.; Cuttler, J. M. (Technion-Israel Inst. of Tech., Haifa). Nucl. Instrum. Methods, 71: 292-6(1969).

The wall effect is examined for the case of thermal neutrons incident on a cylindrical ^{3}He counter. It is shown that the calculated pulse-height spectrum is sensitive to the available energy loss data for protons and tritons, particularly in the region close to the full energy peak. The calculated spectrum, after smoothing and normalizing, is compared with experimental measurements using a 1" diameter proportional counter. (auth)

33412 ABSOLUTE ACTIVITY MEASUREMENT WITH A $4\pi\beta-\gamma$-COINCIDENCE COUNTER. Vuorinen, A.; Kaloinen, E. (Technical Univ., Helsinki). Ann. Acad. Sci. Fenn., Ser. A VI, No. 310, 14p.(Mar. 1969).

The general theory of the $4\pi\beta-\gamma$-coincidence counting is briefly discussed. After a short description of the experimental apparatus the corrections of major importance are reviewed. As a demonstration of the usefulness of the counting arrangement a half-life measurement of ^{198}Au is presented and the attainable accuracies are estimated. (auth)

33413 RADIATION DETECTOR. Huth, Gerald C.; McKinney, Russell A. (to United States Atomic Energy Commission). U. S. Patent 3,449,177. June 10, 1969.

This invention relates to a method of making a semiconductor x-ray detector. The method, comprises deeply diffusing the outer portion of the detector for gettering carrier lifetime effecting impurities from the deeper portion thereof, and removing the outer portion by lapping and/or etching to produce a thin window for the passage of x-rays there-through for the effective and accurate detection of the x-rays and their energy levels in the detector. (AEC)

33414 DIELECTRIC-TYPE CHARGED PARTICLE DETECTOR. Seppi, Edward J. (to United States Atomic Energy Commission). U. S. Patent 3,450,879. June 17, 1969.

This patent relates to a charged particle detector comprised of a thin dielectric in intimate contact with a pair of electrodes across which a voltage is applied to extract a current from the dielectric upon its being irradiated with charged particles that cause the dielectric to become proportionately electrically conductive. (AEC)

33415 USE OF A DIGITAL COMPUTER FOR PROCESSING DATA FROM CALIBRATION EXPERIMENTS OF SURVEY METERS. Moore, Richard; Devi, Sumana; Wingert, Richard (American National Red Cross, Bethesda, Md.). Health Phys., 17: 343-5(Aug. 1969).

The method developed permits point plots of the input data and the calibration curve of the meter and calculation of the relative error of the meter. The method has the advantages of speed, low cost and tabular and graphical records of input data and calculations. (auth) (UK)

33416 RADON DETECTOR SUITABLE FOR PERSONNEL OR AREA MONITORING. Costa-Ribeiro, Carlos; Thomas, James; Drew, Robert T.; Wrenn, McDonald E.; Eisenbud, Merrill (New York Univ., N. Y.). Health Phys., 17: 193-8(Aug. 1969).

A radon detector is described which can be used to measure integrated radon exposure. Radon, but not its daughters, in the atmosphere to be sampled diffuses through a porous medium into a chamber with a sensitive volume of 28 cm^3. A 60 V potential is maintained between a hemispherical screen and an aluminized mylar film covering a zinc sulfide (ZnS(Ag)) coated lucite light pipe. When ^{222}Rn decays, ^{218}Po, which is generally produced as a positively charged ion, is electrostatically collected on the aluminized mylar surface. Decay of ^{218}Po ($T_{1/2}$ = 3.05 min) produces scintillations in the zinc sulfide, which are recorded on a photographic film selected for its sensitivity to the 4500 Å radiation emitted by ZnS(Ag). The film is then developed and the exposure read by conventional densitometry. The results of field and laboratory tests are presented. The instrument has a capability of monitoring atmospheres which average between 40 and 550 pCi/l of radon during a period of 170 hr. (auth) (UK)

33417 COMPUTER PROCESSING AND DISPLAY OF POSITRON SCINTIGRAMS AND DYNAMIC FUNCTION CURVES. Wilensky, S.; Ashare, A. B.; Pizer, S. M.; Hoop, B. Jr.; Brownell, G. L. (Massachusetts General Hospital, Boston). pp 815-27 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

A computer processing and display system for handling radioisotope data is described. The system has been used to upgrade and display brain scans and to process dynamic function curves. The hardware and software are described, and results are presented. (auth)

33418 DIGITIZATION AND DATA PROCESSING OF SCINTISCAN MATRICES BY HIGH-SPEED COMPUTER. Tauxe, W. N. (Mayo Clinic and Mayo Foundation, Rochester, Minn.). pp 803-13 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

A system for digitization of scintiscan matrices by means of an 8-channel digitizing computer-compatible magnetic tape recording device was developed. One of the chief advantages of this system is that the data can be subsequently manipulated mathematically in various ways. Examples include: 1. The summation of absolute counts over an organ such as the thyroid; or part of an organ. These may be expressed in terms of percentage dose uptake or as ratios between various portions of an organ scan. 2. The "focusing" of the scan matrix to accord with the resolving capabilities of the data gathering mechanism. 3. The presentation of multiple scan matrices in which one may be expressed as a function of another. This has effected a quasi three-dimensional scan. 4. The production of scans biased in various linear and non-linear ways to optimize contrast enhancement. Recently an on-line production of such scans was undertaken. Preliminary experience is reported. (auth)

33419 CORRECTION OF RESOLUTION IN SCINTIGRAPHY. Di Paola, R.; Albarede, P.; Tubiana, M. (Institut Gustave-Roussy, Villejuif, France). pp 783-801 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969. (In French).

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

The informational content of activity distribution in an object becomes degraded as it passes through a scintigraphic system,

and this degradation is shown in the image by distortions and by a lessening of the contrasts found in the object. The drawback can be countered by improved collimator resolution, for the collimator is the main cause of poorer modulation in the image. But as the sensitivity of collimated detectors must be sufficient to enable clinical scintigraphy to be carried out, their resolving power is limited. Recovery of the original information from an image distribution by means of response function of the detection system is a general problem that has already been examined in a number of fields. The problem is studied in linear scintigraphy. The experimental nature of the study has given rise to serious problems of interpretation. A UNIVAC 1107 computer was used for both processing and generating images. In this way, object and image distribution before and after processing are strictly comparable. In order to compare different processing techniques (successive unfolding methods, smoothing techniques, etc.) quantitative criteria are needed, and these same quantitative criteria can be used to assess the limits of validity of the recovery operations used to be evaluated. With this aim in mind, sinusoidal sources were studied using as a criterion the modulation transfer function linked with a second test which can be used to assess discrepancies between distribution. The study has made it possible to select the optimum technique and to establish its exact limitations as regards information content and spatial frequency of distributions. (auth)

33420 A COMPARISON OF DATA AVERAGING OF RADIOISOTOPE SCAN DATA BY PHOTOGRAPHIC AND DIMENSIONAL COMPUTER TECHNIQUES. MacIntyre, W. J.; Christie, J. H. (Euclid Clinic Research Foundation, Cleveland. Case Western Reserve Univ., Cleveland). pp 771-82 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

Most data recording systems used in radioisotope scanning display each count or group of counts with a mark of very small spatial dimensions placed on the record in direct relationship to the center of the collimator. Although few collimators used in scanning show an appreciable response to spatial frequencies greater than one cycle per centimeter, the spatial dimensions of the display dot is frequently no larger than one millimeter. For this reason a conventional scan display will exhibit an appearance of high frequency noise which greatly detracts from the ability of the reviewer to recognize small differences in the more gross or low frequency detail. Several techniques have been devised to reduce this noise and improve the visualization of the detail of structures consistent with dimensions resolvable by the collimator. One method has been to combine the counts recorded in adjacent areas to obtain an average count for the entire area segment. Various investigators have used elements ranging from 25 mm to 1 cm, averaged in matrices containing five or nine components. When averaged by computer the program will also adjust values in the matrix that are statistically improbable. A second system has been one of employing a large photographic light dot pattern with dimensions approximating the space and intensity distribution of the point spread function of the collimator. If the increments of x and y axis traversal are small in proportion to the diameter of the light pattern, the intensity at any one spot can be derived from the integration of counts received when the collimator is directed at regions around the center point as well as when directed to the center point itself. The present investigation evaluates the similarities and differences of these methods by constructing three-dimensional models of intensity versus spatial dimensions using photographic discrete point data recording, discrete point recording followed by matrix averaging, and by large photographic spot averaging. (auth)

33421 ANALYSIS OF THE OPTIMUM CONDITIONS FOR DATA DISPLAY AND IMAGE PERCEPTION IN PHOTOSCANNING. Atkins, H. L.; Hauser, W.; Richards, P.; Robertson, J. S. (Brookhaven National Lab., Upton, N. Y.). pp 759-70 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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A discussion of display in the visualization of radioisotope distribution requires prior analysis of the data collection system. It is important to know what spatial resolution can be expected in a given situation. Based on work by Rose and Coltman, a simple relation between count density, spatial resolution and modulation transfer function of a collimator can be established for two special but rather typical situations: (1) a maximum decrease of gamma-ray flux to zero from a "cold area" embedded in tissue having a fairly uniform distribution of isotope (i.e., the ideal situation in liver or thyroid scanning), and (2) an increase in flux to twice that from the surroundings (i.e., a typical situation in brain scanning). The optimum spatial resolution in a given situation can thus be determined with this method, and the data presentation system — specifically the size of the lightspot in photographic display — can be adjusted accordingly. This proposal is tested with phantoms using collimators which differ in sensitivity and using lightspots of different sizes. Good correlation with the theoretically-obtained data is found, and it can be easily shown that with an improper choice of lightspot — either too small or too large for a given count density — information is lost. The same result can be achieved by varying the size of the displayed picture, using a fixed size lightspot. This approach is based on studies by several authors which indicate that contrast threshold for visual resolution varies with spatial frequency. When this is tested with minification of the photographic display, the expected improvement in visibility is found. It is therefore suggested that variation of the minification of the displayed picture according to the optimum spatial resolution, and thus according to the count density, in a given situation would give maximum perceptibility of a lesion. The described approach to the analysis of the optimum display system can be extended to other ratios of gamma-ray flux and to stationary detectors. (auth)

33422 A MAGNETIC SHEET MEMORY. ITS APPLICATION TO THE QUANTITATIVE EVALUATION AND CONTRAST ENHANCEMENT OF SCANS. Winkler, C.; Akhtar, M.; Knopp, R. (Univ., Bonn). pp 739-44 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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As core memories and computers are not available to every laboratory for the storage of scintigraphic data, a simple memory device that can be used with conventional scanners in any isotope department was developed. The memory consists of a magnetic sheet upon which a tape-head moves synchronously with the movements of the detector. The primary, unaltered scan information is stored on the magnetic sheet two-dimensionally. Thereafter, the scans can be played back from the memory with any desired adjustment of the recording device. Another advantage is that the scintigraphic information can be evaluated quantitatively. For this purpose the sheet is covered by a foil in which the areas of interest, e.g., the left and right lung, are cut out. A scaler will then only register the counts from the uncovered areas. Thus, the activity in the right and left lung can be compared with each other which makes it possible to estimate perfusion rates under different conditions. This method and other practical applications of the device are described. (auth)

33423 SCANNING WITH A TOTAL INFORMATION STORAGE AND CONTROLLED DATA PRESENTATION SYSTEM. Rejali, A. M.; Gregg, E. C.; Voelker, W. H.; Friedell, H. L. (Case Western Reserve Univ., Cleveland). Contract W-31-109-ENG-78. pp 731-7 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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Improved clinical results obtained from storing all available information received by the detector or detectors without prior modifications in a permanent memory are described. Permanently stored information is modified later with a special electronic imaging system with kinescope presentation in black and white or color. Under carefully controlled circumstances this system permits immediate and innumerable degrees of erase and contrast enhancement or color coding in fractions of a second. A profile representing the count-rate through any slice in the scanned area may be performed to determine relative distribution of radioisotopes. The advantage of this system and various clinical results in scans of myocardiums, pancreas, cardiac blood pool, placenta, etc., are presented. (auth)

33424 DIGITAL DATA PROCESSING AND DISPLAY IN RADIOISOTOPE IMAGING. Iinuma, T. A.; Nagai, T.; Fukuda, N. (National Inst. of Radiological Sciences, Chiba, Japan). pp 715-29 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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In conventional radioisotope images much information is lost through taking data by analog instruments and displaying them on analog devices. By utilizing appropriate digital instruments, data in radioisotope imaging are taken in the form of a numerical array ("digital image") and each number corresponds to the counts in a small area that is called an "elemental image." If the area of an "elemental image" is much smaller than a resolving area of the imaging system, all useful information is contained in the "digital image." Since the radioisotope image must be interpreted by the

human visual system at present, the resulting "digital image" should be so processed that human eyes can easily extract the diagnostic information from the image pattern. Three methods of image processing are described: (1) "smoothing" (2) "focusing" (restoring) and (3) "differential imaging." A preliminary experiment using a thyroid phantom was performed and the results showed the effectiveness of the image processing. (auth)

33425 DIGITAL PROCESSING FOR MODIFYING AND REARRANGING RECTILINEAR AND SECTION SCAN DATA UNDER DIRECT OBSERVATION. Kuhl, D. E.; Edwards, R. Q. (Univ. of Pennsylvania, Philadelphia). Contract AT(30-1)-3175. pp 703-13 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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Our digital processor for scan data is an on-site instrument that is intermediate in complexity between conventional optical processing devices and large digital computers. It is designed to provide for a wide and flexible range of secondary data operations, direct picture display on a CRT screen, and full operator control of both processing and display operations at the time of viewing. The instrument does not require the user to learn complicated programing schemes. The operator is expected to be a physician who will control the parameters of interest by punching preset buttons on a keyboard while observing changes displayed on a CRT screen. The system functions primarily as an investigative tool for studying perception of scan information and ways of making this information more meaningful. Data operations include data bounding, spatial averaging, iso-count line generation, image addition and subtraction, and several forms of quantitative read-out for analysis of regional data. The instrument is intended to serve as a central processor and reader for data from several units. Investigations with this processor have served as a source of information leading to the design of more simple processing devices suitable for wider acceptance. For example, the Mark III rectilinear and transverse section brain scanner that has evolved from this project is expected to be a practical improvement of the brain study method. This instrument is designed especially for rapid brain scanning using ^{99m}Tc pertechnetate. It has a self-contained computer, integrated digital circuits for compactness and economy, and provision for transverse section scanning. The advantages of this system are that it provides a more thorough study using both transverse section and rectilinear modes, rapid performance, precise orientation of section and rectilinear views to the patient position, efficient transfer of information between physician and machine during studies, and economy of design which should encourage wide application. (auth)

33426 A DATA STORAGE, PROCESSING, AND DISPLAY SYSTEM FOR RADIONUCLIDE IMAGING. Natarajan, T. K.; Wagner, H. N. Jr. (Johns Hopkins Medical Institutions, Baltimore). pp 697-701 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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Present imaging systems have limited data storage capabilities and most do not permit data processing while the physician simultaneously views the image. A system that permits storage of integrated pulses arising from radionuclide scanners, data processing, and display of the activity distribution by means of a three-color kinescope is described. Each of eight colors — black, white, yellow, green, cyan, blue, magenta, and red, in that order — corresponds to fractional increases in count-rate from the lowest to the highest. For example, black portrays count-rates from 0 to $\frac{1}{8}$ of the maximum, while red delineates the areas of maximum count-rate. Provision is made to permit subtraction of a fixed count-rate before the data display in color. Various amounts of background subtraction can be made while the observer views the resultant image. The original data stored on incremental magnetic tape are not destroyed during the process. Integration of counts is done over the period required for the scanner to travel $\frac{1}{8}$ of an inch. The field of view always contains 10,000 image cells over a 12 × 12-in. area, which can be displayed at 60 times/sec to produce a flicker-free image on the kinescope. With reduction in the size of the area under study, the 10,000 cells can be used to construct images of smaller size, but with improved resolution. The system is being improved to permit storage, processing and presentation of multiple views. Computations can be made relating areas observed on multiple views. (auth)

33427 ANALOGUE HANDLING OF SCINTIGRAPHIC DATA. GENERATION OF ISOACTIVITY LINES AND MEASUREMENT OF ORGAN SIZE. Kuni, H.; Graul, E. H.; Belzer, H. (Univ., Marburg, Ger.). .pp 687-96 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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The total scintigraphic information is stored on a photographic negative under standardized conditions without any manipulation, such as background subtraction, etc. The standardized rescanning of the developed picture by means of a closed-circuit TV generates a video signal which is distorted by a nonlinear amplifier so that a certain voltage difference in the video signal represents a certain degree of statistical significance of the difference between the counts that are responsible for the difference in voltage. A Schmitt trigger circuit which generates an impulse of constant height if the video signal exceeds a chosen threshold is described. The presentation of the output signal on the screen of the TV monitor shows all parts as uniform black areas containing more activity than the threshold level. An analogue integration circuit generates a voltage proportional to the size of the uniform black area. After the trigger threshold is set at the right level, the size of the organ can be read on a voltmeter. The square-topped pulse generated by the Schmitt trigger is differentiated. The polarity of one of the resulting two pulses marking the beginning and the end of the square-topped pulse is changed; thereafter both are added, shaped and presented on the TV monitor. The presentation of the combined signals shows only the border of the black areas. This border is identical with an isoactivity line. By using more than one Schmitt trigger with a constant voltage difference, which is adjustable according to the desired degree of significance of the distance between the isoactivity lines, a set of isoactivity lines with "equisignificant" distances can be generated. This analogue mode of analyzing scintigraphic data gives the same information as the digital mode with digital computers. The accuracy of this method is sufficient, and the costs of this system are one-tenth of those of a digital computer. (auth)

33428 INHERENT PROBLEMS IN THE QUANTITATION OF ISOTOPE SCAN DATA. Johnston, R. E.; Brill, A. B. (Vanderbilt Univ., Nashville). Contract AT(40-1)-2401. pp 617-31 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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Knowledge of the factors influencing the quantitation by external counting systems of the amount of an isotope in a variable geometry scattering media, such as man, is needed for dosimetry calculations and for numerical analysis of scan data. Analysis of the energy spectrum (i.e., ratio of relative intensities of photopeak and Compton scatter, for example) from a distributed source in a defined scattering media has been suggested as a means of determining effective source depth. Experimental measurements reveal that this ratio may be useful in those circumstances where the size of the source is small with respect to the field of view of the detector. Narrow beam and broad beam single-hole collimated detector systems, and a multihole focused collimated system were used with different size sources of ^{99m}Tc and ^{131}I in a water phantom. The basic components of the spectra (Compton scatter, unscattered photopeak, and lead x-ray produced in the collimator), were resolved using a computer program. A plane source of infinite extent relative to the field of view of the collimator results in peak-to-scatter ratios essentially invariant with depth. Plane sources equal to or smaller than the field of view of the collimator result in peak-to-scatter ratios that change with depth of the source in the scattering media. The information upon which these conclusions are based are presented in detail. Investigations of the energy spectrum from an infinite plane source of ^{131}I suspended in a scattering media and viewed with a multihole focused collimator, show that narrow angle scatter of the 365 keV and large angle scatter from the higher energy components result in a disproportionately large number of counts in the 365-keV energy range. These scattered counts originate from the surrounding field of activity, rather than from the focal region. These experimental data indicate that radionuclides with multiple unwanted high-energy transitions, such as with ^{131}I, have limited value for the detection of small anomalies in large organs. Knowledge of the radiation interactions in a scattering media must be considered when choosing a radiopharmaceutical, as well as the detector and collimator for a particular application. The interrelations between these experimental variables are discussed. (auth)

33429 EFFECTS OF SCATTERED RADIATION ON SCINTILLATION DETECTOR RESPONSE. Beck, R. N.; Schuh, M. W.; Cohen, T. D.; Lembares, N. (Univ. of Chicago). pp 595-616 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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A complete analysis of the response of a collimated scintillation detector to an in-vivo distribution of radioactivity must include the

responses to both unscattered gamma rays and the continuous spectrum of scattered photons produced by Compton interactions in the tissue. The effects of scattered radiation on the detector sensitivity and spatial resolution (or modulation transfer function (MTF)) are determined, respectively, by the magnitude and shape of the response to scattered photons from an object element, such as a line source of radioactivity. These effects are functions of the distribution of radioactivity, the gamma-ray energy, the energy resolution of the detector and the base line setting of the pulse-height analyser. In general, sensitivity is decreased and spatial resolution is improved as the base line setting is increased. When the statistical figure of merit (which is proportional to the product of the sensitivity and the MTF^2) is used as a criterion of system quality, an optimum base line setting can be found for a specific application. For brain scanning with gamma-ray emitters in the energy range of 140 to 511 keV, the optimum window setting almost precisely brackets the unscattered photopeak. Although the modulation transfer function describe the response to sinusoidal distributions, it is shown that the response to more complex objects in a scattering medium can be computed from the line spread function, measured in a scattering medium, or from the associated MTF. (auth)

33430 DESIGN OF MULTICHANNEL FOCUSED COLLIMATORS FOR SCINTILLATION SCANNING. Husak, V.; Perinova, V.; Kleinbauer, K. (Palacky Univ., Olomouc, Czechoslovakia). pp 575-93 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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A new procedure for the design of multichannel focused collimators is described. New precise formulae are derived which express the number of holes and the efficiency of collimators with a hexagonal arrangement of holes and an arrangement of holes in concentric rings. Below the gamma-ray energy (approximately 150 keV) the optimization procedure is similar to that suggested by Beck. At higher energies, using the expression of Rotenberg and Johns for the minimum path length through the septa of gamma ray, a general equation for the efficiency of multichannel collimators is obtained. Assuming a set of design parameters to be given, a length of the collimator is found which maximizes the efficiency. This procedure seems to be less laborious than the one suggested by Beck. A comparison is made of both approaches from the viewpoint of the design of the collimator with the stated parameters. Calculations are extended to collimators with segmented channels in the form of a cut circular annulus. The efficiency of the segmented channel is 56% higher than the efficiency of the circular channel, assuming approximately the same resolution for both channels. By means of Beck's theory as well as the authors' approach, equations are derived for optimizing the design of multichannel collimators with segmented holes. Four optimum collimators with segmented holes determined for scanning studies were fabricated. An inexpensive and partly new technique was used for the construction of the 269-hole collimator for scanning with low-energy emitters (septum thickness 0.5 mm of Pb). Collimators for higher energies were fabricated by casting. The efficiency of collimators calculated from their dimensions agrees fairly well with the experimental results. The relationship between the collimator radius of the field of view and the experimentally determined values of the point-source resolution is discussed. (auth)

33431 IMPROVED SCINTISCAN RESOLUTION WITHOUT SENSITIVITY LOSS. CONSTANT-RESOLUTION COLLIMATOR. Genna, S.; Farmelant, M. H.; Burrows, B. A. (Boston Univ. Boston Veterans Administration Hospital). pp 561-74 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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Although conventional multiaperture collimators enable the use of large detectors without loss in resolving power at the focal plane, the resolution for regions distant from this plane are generally inferior. Two factors contribute to this deterioration: (a) the magnitude of the solid angle subtended by the crystal detector at the focal point, and (b) the conventional use of collimator holes of equal cross-sectional area. Reduction of the solid angle subtended by the crystal is accompanied by proportionate reduction in sensitivity. However, by the simple expedient of fabricating multihole collimators so that the cross-sectional areas of their conical holes are reduced with increasing distance from the collimator axis, the resolution is significantly improved without loss of sensitivity. A particular "constant-resolution" collimator, which has been designed for use with a multidetector scintiscanner, illustrates this effect as well as the effect of reduced detector solid angle. The depth-of-field of this collimator, which is defined as the distance through which the resolution does not differ by more than 10% from its mean, is approximately 15 cm. The depth-of-field of two opposed collimated detectors viewing a scattering medium (water) is about 30 cm. (auth)

33432 DESIGN AND ANALYSIS OF SCINTILLATION-CAMERA LEAD COLLIMATORS USING A DIGITAL COMPUTER. Walker, W. G. (Nuclear-Chicago Corp., Des Plaines, Ill.). pp 545-60 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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The performance of the parallel, multihole, lead collimator of a gamma-ray scintillation camera in terms of its efficiency, resolution, depth response and maximum gamma-ray energy properly imaged, is determined by the hole shape and size, the thickness and the septum thickness of the collimator. The performance characteristics are all inter-dependent, and, for a given maximum gamma-ray energy, a large number of collimator parameter values will give a wide range of performance. A manual evaluation of this performance is a very long and tedious process and, in general until now, evaluation at relatively widely spaced discrete collimator parameters only has been performed. However, with the advent of the need for specialized collimators, more exact methods are required. A method of designing and analyzing the performance of scintillation-camera parallel, multihole collimators using a digital computer is described. A suitable FORTRAN IV program is written and run on an IBM 360/30 computer and information on efficiency, resolution and depth response obtained for a wide range of potential collimators. In addition, since the total resolution of the scintillation camera depends on the inherent resolution of the crystal-photomultiplier tube assembly, measured figures of inherent resolution are incorporated in the program and the total resolution values calculated. The information obtained, which is printed out in an easily readable format, then allows one to assess specific designs and choose the optimum for a particular situation. Comparisons between the performance predicted by the computer design equations and practical measurements are also given. (auth)

33433 COMPARISON OF THE DIAGNOSTIC VALUES OF CAMERA AND SCANNER SCINTIGRAMS. Yasukochi, H.; Ishikawa, D.; Yamazaki, T.; Miyamae, T.; Lin, S. (Tokyo Univ.). pp 529-42 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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Based on experience of 12 years with scanners and 6 years with scintillation cameras, the problems concerning the choice of scintigraphic instruments are presented. The physical and the clinical factors which affect the evaluation of scintigrams are discussed. The main emphasis is given to the physical problems though the clinical problems are considerable depending on the purpose of the scintigram. It may be employed for determining the organ size, to localize a tumour or to find non-functioning sections of an organ. To solve these problems the dot density of scintigrams is determined by the integration of isoresponse curves obtained with a scanner or a scintillation camera. The isoresponse curves depend on four components: the sensitivity and the resolution in a plane parallel to the radiation detector, the resolution factor along the central axis and the gamma-ray absorption. The integration is performed with an analog computer. Some scintigrams of representative organs were calculated and evaluated according to the needs for clinical diagnosis. The choice of the scintigraphic apparatus depends on the physical problems, the administered dose of radioisotopes, the diagnostic purpose of the scintigram and the condition of the patient. (auth)

33434 COMPARISON OF GAMMA-RAY IMAGING DEVICES WITH A NEW THREE-DIMENSIONAL PHANTOM. Hayes, M. (Univ. of California, Los Angeles). Contract AT(04-1)GEN-12. pp 523-8 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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Studies with point or line sources of radioactivity and of angle-plane phantoms fail to characterize completely differences in imaging capacity between gamma camera devices and conventional scanners with focused collimators. Moreover, the results often fail to help the physician in the assessment of clinical scanning problems. A new three-dimensional phantom has been devised. It consists of solid rods or hollow tubes of different diameters positioned diagonally in a plastic tank. With this phantom, the imaging capacity of an instrument can be determined simultaneously at increasing depths by a single scan examination. This apparatus is a modification of a phantom originated by G. J. Hine which consisted of a radioactive line source running diagonally from top to bottom of a cube-shaped container. Radioactive tubes in the new phantom were

scanned in air and in water. Inactive rods were scanned in a radioactive water background. Comparative studies with ^{99m}Tc have been completed with a 3-in.-diameter crystal scanner, a 5-in. dual-probe scanner, a ten-probe rapid scanner, an Anger camera and a Ter-Pogossian image amplifier camera. Similar studies with additional scanning devices and with other scattering media and radionuclides are in progress. So far, the Anger camera has shown the best overall imaging capacity at all depths for radioactive tubes in air and water, whereas with conventional focused collimator scanners, the tubes are visualized best only at depths within the focal planes of the collimators. The capacity to image inactive rods in a radioactive background was relatively poor for all instruments studied. However, under these conditions, the conventional 3-in. crystal scanner was most satisfactory. (auth)

33435 TEST PATTERNS TO DETERMINE SENSITIVITY AND RESOLUTION OF SCINTIGRAPHY. Kakehi, H.; Arimizu, N.; Uchiyama, G.; Saegusa, K.; Tateno, Y. (Chiba Univ. School of Medicine, Japan). pp 509-21 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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The quality of a scintigram is one of the most important factors governing the diagnostic value of scintigraphy. The quality of a scintigram is not only decided by the instrumentation, techniques of scintigraphy and the kinds and amounts of radiopharmaceuticals administered, but is also influenced by the distribution of radionuclides in a target organ and its surroundings. All these factors are so complicated that it is difficult to analyze the quality of a scintigram and to make comparisons by simple methods. The quality of a scintigram is usually expressed by three parameters: resolution, sensitivity and background contribution. These parameters can be relatively easily determined by analyzing the scintigrams of the selected test patterns which are composed of three-dimensional arrangements of radioactive sources particularly designed for this purpose. This fact has been proved by several hundred scan experiments performed with many phantoms and test patterns. The result suggests that the particular combination of line sources arranged on a plane and the particular forms of plane sources piled up to a block can be applied as useful test patterns. (auth)

33436 EVALUATION OF FOCUSED COLLIMATOR PERFORMANCE. III. THREE- AND FIVE-INCH-DIAMETER COLLIMATORS FOR ^{131}I AND ^{99m}Tc. Hine, G. J.; Tsialas, S. P. (International Atomic Energy Agency, Vienna). pp 487-507 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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Focused collimators for radioisotope scanning must be chosen according to their spatial resolution as a function of source-to-collimator distance, their plane-source sensitivity, and their septa penetration. All three parameters are determined from the response of a collimator to a uniform line source of a selected radionuclide. The line-source response is determined at 2.5-cm intervals from the face of the collimator by moving the line source in air at right angles to the central axis of the collimator and plotting the count-rate as a function of the source position. Seventeen commercial collimators from the Picker and SELO companies have been investigated. Seven of the collimators are for 5-in.- and ten for 3-in.-diameter sodium iodide crystals; eleven collimators are designed for ^{131}I and six for ^{99m}Tc gamma rays. Additional measurements are performed with the moving line source in water to investigate the effect of an absorbing medium on the performance of the collimator. For equal focal distance, the larger diameter collimators have the advantage of higher sensitivity, but the distinct disadvantage that their spatial resolution deteriorates more rapidly with depth on either side of the focal plane compared with the smaller diameter collimators. As the depth interval of high resolution gets shorter, the distance of the organ to be scanned from the collimator becomes more critical and the average resolution of the collimator varies with the position and thickness of the organ along the axis of the collimator. A focal distance of about 10 cm appears to be optimum for scanning all major organs. In scans of large organs (liver, lung and brain) the fraction of gamma rays detected is reduced by gamma-ray attenuation which increases with depth. With a pair of opposed long-focus 3-in.-diameter collimators a spatial resolution and depth response can be achieved that do not vary much over a depth of 25 cm for the gamma rays of ^{131}I within an absorbing medium. The geometrical specifications and the performance of focused collimators are essential for comparing collimators of different designs and for the correct use of a given collimator. (auth)

33437 PERFORMANCE OF FOCUSED COLLIMATORS MANUFACTURED BY THREE JAPANESE COMPANIES. Iio, M. (Tokyo Univ.). pp 473-86 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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According to the scheme developed by Hine, IAEA, for presenting the geometrical specifications of focused collimators and their physical properties for scanning of extended sources, fifteen collimators manufactured by three Japanese companies were evaluated. Three parameters, spatial resolution, plane-source sensitivity and septum penetration, are determined using line sources ^{131}I and ^{141}Ce. The performances of commercial collimators from Shimadzu, Aloka and Toshiba companies are presented. Three collimators are made for 5-in. and twelve for 3-in.-diameter sodium iodide crystals. Eleven collimators are designed for ^{131}I and four for ^{99m}Tc gamma rays. The survey of these collimators shows that a knowledge of the performance and of the specifications of focused collimators is essential for the optimum use of each collimator and for the correct selection of the dose to be administered in scans of organs. (auth)

33438 A COMPARISON OF LINE SPREAD FUNCTIONS OF FIVE- AND EIGHT-INCH COLLIMATORS WITH THREE-INCH AND TAPERED BORE COLLIMATORS. Christie, J. H.; MacIntyre, W. J. (Euclid Clinic Research Foundation, Cleveland, Case Western Reserve Univ., Cleveland). pp 457-72 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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To increase the sensitivity of the moving detector scanning system, 5- and 8-in.-diameter detectors have been utilized, along with collimators matched to these spatial dimensions. The effective increase in sensitivity has not been found to be linear with area; however, since, in general, smaller hole dimensions are required with the larger diameter collimators to obtain the same average resolution. In the present investigation, the line spread functions, along with the modulation transfer functions derived from them, have been selected for collimator evaluation. The integration of the line spread function will yield an expression for plane sensitivity since the integration of a line source response is equivalent to measuring the response from a plane source. The modulation transfer function relates the response of a linear component of a scanning system to the frequency of a plane source modulated sinusoidally in one spatial dimension. This function can be expressed as the normalized Fourier transform of the line spread function. Both the line spread and the modulation transfer functions have been obtained from Ohio-Nuclear 5- and 8-in. collimators and compared with similar measurements with 3-in. focusing and tapered bore collimators. It has been recognized that one of the primary concerns with collimators of larger diameters involves the variation of resolution with the displacement of vertical distance from the collimator's face. In order to obtain a practical comparison of the line source response of the various collimators, the variation of the response over the entire depth has been examined. For collimators used in thyroid scanning, the region of interest may involve levels one centimeter above and below the focal plane. For collimators used in large organ scanning, response up to five centimeters above and below the focal plane should be considered. To ascertain the practical evaluation of the larger collimators, plane sensitivities should be compared between collimators of equivalent resolution. In addition, the resolution at the focal plane may not be as significant as the resolution over the entire depth of interest. (auth)

33439 LINE SOURCE RESPONSE FUNCTION MEASUREMENTS AND MODULATION TRANSFER FUNCTION CALCULATIONS PERFORMED ON SOME NUCLEAR-CHICAGO AND OHIO-NUCLEAR COLLIMATORS. Ross, R. D.; Cradduck, T. D. (Manitoba Cancer Foundation, Winnipeg). pp 437-55 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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The measurement of the response of a collimator to a line source of activity presents a simple yet effective way of establishing the spatial resolution of that collimator. Further, the same response can be used to give a measure of the sensitivity of the collimator-detector system to a plane source of activity and can also be used to calculate the modulation transfer function of the collimator. The line source response functions of some 3-in. Nuclear-Chicago and some 5-in. Ohio-Nuclear collimators were measured. The mechanical scanning sequence, data collection and data storage were automated. Calculations of correction for decay, normalization, sensitivity and modulation transfer function were performed on a Digital Equipment Corporation LINC-8 computer. These programs were written in Fortran II and can be made available to

interested parties. A brief description of the equipment used and a summary of the results of the measurements made are presented as well as a cursory examination of the more unique properties of the computational methods. (auth)

33440 SENSITIVITY AND RESOLUTION IN RADIOISOTOPE SCANNING. A REPORT TO THE INTERNATIONAL COMMISSION ON RADIATION UNITS AND MEASUREMENTS. MacIntyre, W. J. (Case Western Reserve Univ., Cleveland); Fedoruk, S. O.; Harris, C. C.; Kuhl, D. E.; Mallard, J. R. pp 391-435 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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Concepts of resolution and sensitivity that appear compatible with both moving-detector scanners and stationary-detector devices are developed. While the sensitivities measured from various sources are described, plane sensitivity was selected as the one most useful for system comparison. The line spread function and the modulation transfer function derived from it were selected to provide the description of the resolution of the system or for any component of the system. Both theoretical and practical considerations of the application of these concepts to moving-detector scanners and stationary-detector devices are discussed. (auth)

33441 RECORDING SCAN DATA IN PHOTOGRAPHIC COLOR DURING LIVE TIME. I. FROM THE CONVENTIONAL SCANNER. II. FROM A TEN DETECTOR SCANNER. Adams, R.; Jaffe, H. L. (Cedars-Sinai Medical Center, Los Angeles). pp 331-46 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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Instruments for scan recording in color were developed, combining the speed, versatility and silence of the cathode-ray tube, the contrast and latitude of a photographic process, and the rapid development of Polaroid color film. The electron beam of a modified cathode-ray oscilloscope is made to track the motion of the scanner detector. The beam is normally off but is flashed on at each impulse from the scanner analyzer. The screen is photographed in color during a time exposure through a train of color filters driven back and forth through the lens system of the camera by a servo mechanism controlled by the ratemeter circuit of the scanner. The instrument is calibrated so that the maximum intensity photographs in red. As count-rates decrease, other filters are driven into place to photograph the screen in continuously varying saturated hues of orange, yellow, green, blue and violet. Examples are shown from scans of models and from the 17,000 clinical color scan library, demonstrating enhanced contrast, extended dynamic range, and quantitative information at a glance. More recently, an instrument for recording scan data in color from a ten detector moving scanner system has been designed. As usually employed, the Dynapix presents scan data on the screen of a cathode-ray tube as flashes of varying intensity appearing sequentially in rows and columns at a repetition frequency up to 200/sec, and too rapid for the system previously described. In the new color version of the instrument, color filters mounted in a wheel between the lens elements of the camera are driven at a continuous 9400 rev/min. The electron beam is pulsed by intensity modulated time delay so that an input signal of maximum amplitude delays the flash until red filter is traversing the lens opening. Signals of lesser amplitude are converted to decreasing time delays, resulting in flashes photographing as corresponding hues of orange, through violet. The recording may be either live or played back from magnetic tape. Scans are shown comparing this color system to the usual grey scale. (auth)

33442 ESTIMATING THE SPATIAL DISTRIBUTION OF RADIOACTIVE ISOTOPES. Nikeshichev, V. N. pp 323-9 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969. (In Russian).

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

An attempt is made to apply the Kolmogorov–Wiener theory and the results of the work by Shannon to the problems of radioisotope scintigraphy. The smoothing and probability methods used by them are of considerable interest within the theory of pulse detection and can evidently be successfully used in establishing mathematical gammatomography. According to the theory of Kolmogorov and Wiener, for stationary processes with normal statistical distribution, linear smoothing and assessment of probability by the least-squares method represents the absolute optimum, whence it follows that any non-linear method of treating the scintigram cannot improve the primary information it contains. The transmission function of the optimal filter for smoothing and assessing probability is theoretically constructed. Rectilinear smoothing and isolation of the signal causes loss of phase structure when averaging and assessing probability. The procedure for obtaining a more precise determination of the magnitude of build-up over background thus leads to decreased accuracy in the coordinates of build-up. The question whether or not there is build-up of radioactivity over background, and the extent of this, can be most reliably answered from the value of the autocorrelation function, but it is not possible to indicate where this is localized within that part of the body under investigation. The author suggests that these methods afford a unique approach to designing apparatus for radioisotope scanning. (auth)

33443 VISUALIZATION IN SCANNING. Mallard, J. R.; Wilks, R. J.; Cornfield, J. R.; Flook, Valerie (Univ. of Aberdeen, Scotland). pp 305-22 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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Visualization is developed as a process involving a model of eye and brain function, display performance and counter performance combined with the spatial frequency components in the object scanned. The performance of a scanner or gamma camera depends in part on its display system and experiments have been performed to determine the fractional change in count-rate which can be perceived by the eye from color, photoscan and cathode-ray tube displays, for both circular and line sources of radioactivity. For circular sources, color and photoscan displays are capable of making 10% increases in count-rate perceptible in backgrounds ranging from 5 to 100 counts/s for sources of 1 to 4 cm diameter, while cathode-ray tube and black-mark displays show only 20% at best. The results for line sources are also given. In testing for the statistical significance of count-rate differences on a scan, the counts are usually compared for equal areas. On this basis the cathode-ray tube display is only able to show five standard deviations of difference whereas color and photoscan displays show from 2.5 to 3 standard deviations, levels not usually accepted statistically as significant. It is suggested that if the eye examines the areas surrounding the area of interest then the significance of a count-rate difference may be established more accurately and in general will be increased, thereby accounting for the visualization of apparently "insignificant" regions. This theory is used to predict the areas of count density which should be visually perceived in the presence of noise, and extended to consider practical display conditions, which have been described in this paper. The performance of a scanner can be considered in terms of its modulation transfer function (derived from a line spread function). Fourier analysis is performed of simple objects, (e.g., discs, lines, etc.) so that the shape is defined in terms of fundamental and harmonic spatial frequencies. The performance of a counter and collimator for a selected object is then calculated from the MTF values and compared directly with phantom measurements. (auth)

33444 EVALUATION OF SCANNING PROCEDURES IN TERMS OF INFORMATION THEORY. Harper, P. V.; Beck, R. N.; Cohen, T. D. (Univ. of Chicago). pp 289-303 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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While a number of efforts have been made to analyze scanning procedures in terms of information theory, the formulation of scanning resolution using modulation transfer has enlarged the scope and flexibility of the subject and provided additional avenues of approach. It becomes possible to compute the amount of information which can be transmitted in any space frequency component of the image in the presence of the statistical fluctuation of radioactive decay. Manipulation of scanning data by background subtraction, contrast enhancement, data blending, spatial filtering, et cetera, either reduces the information density in the scan or leaves it unchanged, but never increases it, and under conditions where viewing and read-out parameters are not controlling factors, the information density appears to be a basic limitation on the attainable scanning image quality. The basic formulation assumes an information cell in the image as one square wave length of the space frequency component concerned. The received message is defined as the difference between the counts collected in the high half of the cell: 0 to π; and in the low half: π to 2π. The transmitted message, unperturbed by statistical fluctuation (noise) is the same difference expressed as a true mean count. Shannon's expression for the transmission of information in the presence of noise may then be applied: $I = (H(y) - H_x(y))$; that is, the transmitted information is equal to the entropy of y, the received message, minus the entropy of y, when x, the transmitted message, is known. This leads to a simple expression in mean count density,

system modulation transfer function, and space frequency which is closely related to the statistical figure of merit proposed by Dewey and Sinclair, and by Beck. The response to a sine wave test pattern with constant average count density and unit modulation provides an instrumental performance criterion in which actual scans and computed information densities correlate in a meaningful way, and system optimization in terms of information density determines uniquely the space frequency, collimator radius of view, and mean count density. The extension of this method of analysis to real objects appears reasonable and possible. (auth)

33445 THE CHARACTERISTICS OF AVERAGING DEVICES FOR RADIOISOTOPE SCANNING. Smirnov, V. F. pp 273-87 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969. (In Russian).

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

The author analyses the characteristics of scanning systems of differing electronic design for averaging the pulse signal from a radiation detector with a view to subsequent reproduction of the modified signal on a scintigram. These averaging devices include count-rate meters, "sliding mean" meters and other possible means of transforming a sequence of statistically distributed pulses into a relatively smoothly varying signal, proportional to the average frequency with which the pulse arrive. In considering any of these pieces of apparatus, such as the Campbell current pulse generator, the form of which is characteristic of a given type of averaging device, one factor introduced is the effective averaging time which, together with the average frequency with which the pulses arrive from the detector, determines the relative fluctuations of the signal emitted from the device. This parameter is evaluated and the other characteristics of the varying types of averaging device compared; namely, the modulation transfer and phase shift functions when the spatial frequency spectrum is reproduced on the scintigram. Attention is drawn to the advantages of certain types of averaging device in comparison with count-rate meters and, in particular, to the fact that in a "sliding mean" meter the linear phase shift is not dependent on the spatial frequency of the activity distribution under investigation. An equation for the collimator's modulation transfer function is derived assuming, as is borne out by experiment, a Gaussian distribution for the recording efficiency of a collimated detector for radiation from a point source. By simultaneous examination of the transfer functions of a collimated radiation detector and averaging device it is possible to introduce general parameters characterizing the scanner as an averaging system. This, in turn, makes it possible to find a relation determining the optimum choice of parameters for single- and multichannel collimators and averaging devices of varying types, depending on the spatial frequency. (auth)

33446 FLUORESCENT SCANNING. A NEW INVESTIGATIVE TECHNIQUE. Hoffer, P. B.; Charleston, D. B.; Beck, R. N.; Gottschalk, A. (Univ. of Chicago). pp 261-71 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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A method has been developed for imaging the thyroid gland and other organs through the use of K-shell fluorescence. Although the iodine content of the average thyroid gland in only 0.04% by weight, this quantity is sufficient to act as the target for scanning. No radioactive nuclide is introduced into the patient. This technique incorporates the basic scheme of an x-ray fluorescent spectrometer. Americium-241 is used as a relatively monochromatic gamma radiation source (for each 100 alpha disintegrations, americium-241 emits 36 gamma rays at 59.6 keV and lesser numbers of gamma and x-rays below 26.4 keV). The detector is a lithium-drifted silicon crystal with energy resolution of 500 eV FWHM at 30 keV. Both the americium-241 source and the detector are housed in the same lead collimator block. The scanning subject is placed beneath the block, and the source-detector housing scans the subject in a rectilinear pattern. Thyroid scans obtained with this system require a radiation dose to the thyroid gland of 500 mR or less. The information obtained with the fluorescent thyroid scan is unique. It describes the distribution and relative concentration of stable iodine within the thyroid gland. This information will serve as a valuable adjunct to conventional thyroid scans and studies. In addition, other elements with high atomic numbers can be used for imaging. Inert tracers such as barium sulfate-colloid have been used to visualize the liver in experimental animals. Since gamma-ray source and detector are both collimated at the point of intersection of the collimator fields of view, a unique plane within the organ is defined, and laminography is possible. Finally, if higher-energy gamma or x-ray sources are used in combination with solid-state detectors, nonradioactive tracers containing high atomic number elements, such as mercurial diuretics, gold colloid, and bismuth citrate, may be used for deep organ scanning. (auth)

33447 COMPTON-SCATTERED GAMMA RAYS IN DIAGNOSTIC RADIOGRAPHY. Clarke, R. L.; Van Dyk, G. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 247-60 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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It has been shown by Lale (1959) and Clarke (1965) that observation of Compton-scattered gamma rays is potentially useful in diagnostic radiography. Photons from a well-collimated beam are scattered at a particular volume element in the subject, and enter a set of focused collimators to be detected by scintillation counters. The volume element is determined by the geometry of the collimators. The intensity of scattered radiation is proportional to the electron density in the sensitive volume. Scanning this volume over a section of the subject gives a density distribution. The system seems promising for the delineation of internal organs without patient preparation. It is less sensitive than conventional radiography to shadowing and interfering effects. An experimental system capable of scanning small phantoms has been used to test density and spatial resolution, and backgrounds. Density differences of 5% or less may be seen. For local exposures of 0.1 to 1 R, resolutions of the order of 1 cm^3 can be achieved. The physical and practical limitations are described. (auth)

33448 LAMINOGRAPHIC SCANS WITH FOCUSED COLLIMATORS OF 10- AND 20-CM FOCAL LENGTH. Peterson, R. E.; Jackson, H. L. (Veterans Administration Hospital, Iowa City, Iowa). pp 235-45 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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A dual 5-in. sodium iodide crystal scanner with some new scanning options was evaluated. These detectors move at up to 200 cm/min. They can be positioned as synchronized opposed crystals at distances of up to 50 cm. They can also be positioned side by side, adjusted at various angles to focus on a common point at varying depths. The outputs can be displayed individually or summed and the spectrometer windows can be adjusted to collect two separate radionuclide energy intervals. Three pairs of honeycomb collimators include: a 85-hole collimator with a focal length of 10 cm, a 151-hole collimator with a focal length of 10 cm, and a 253-hole collimator with a focal length of 20 cm. In addition to line spread functions and modulation transfer functions for some of these options, clinical examples are shown to contrast the results of conventional scanners with the new possibilities in this system. (auth)

33449 A DUAL DETECTOR SCANNER FOR QUANTITATIVE UPTAKE AND ORGAN VOLUME STUDIES. Williams, E. D.; Glass, H. I.; Arnot, R. N.; De Garreta, A. C. (Hammersmith Hospital, London). pp 665-83 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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By using a suitable collimator design, it is possible to obtain with a dual detector scanner, a summed detector response independent of the depth at which activity is situated within a body. Such a response implies that the counts/sec per μCi of activity in an organ, as measured in the detecting system, will depend only on the thickness of the tissue surrounding the organ, and not on the depth of the organ below the surface of the body. By adding the "dots" within the area of interest and allowing for tissue background, it is possible to measure the absolute, as well as the relative, uptake within this area. This is done by comparing the net dot count with that obtained when a phantom of comparable area, placed in a water tank of appropriate depth, is scanned. The phantom must contain a known activity or a known fraction of the injected activity. Corrections for the variation in body thickness and for the decay of the isotope during the scan are applied where required. A scanner, incorporating two 3.5-in.-diameter by 3-in.-thick crystals, and a moving couch system, was used in three quantitative studies. The depth response of the dual collimator system was measured with line sources, and also with extended sources of limited size. These responses were measured at 140 and 511 keV. The technique was applied in double isotope splenic function studies using ^{81}Rb and ^{51}Cr; in thyroid uptake studies using ^{99m}Tc; and splenic blood volume studies using ^{11}C and ^{81}Rb. (auth)

33450 CLINICAL APPLICATION OF COLOR MODULATION OF GAMMA ENERGY AND DEPTH BY DUAL-CHANNEL SCANNING. Kaplan, E.; Ben-Porath, M. (Veterans Administration

Hospital, Hines, Ill.). pp 375-88 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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A dual-channel scanning system has been described permitting the simultaneous imaging in individual color of the distribution of two gamma-emitting radioisotopes. In those cases where two organs are adjacent and concentrate the same isotope, they may be displayed in separate color if one of the organs concentrates another gamma-emitting isotope with a different energy. This is accomplished by individual color readout of this isotope and the display of the subtraction of this isotope from the common isotope in another color. By using two facing scintillation probes on either side of the individual being scanned, two overlapping organs at different depths concentrating the same isotope can be color differentiated by a dual-channel playout of each probe. The principal application of these dual-channel scanning methods to date has been the simultaneous display of the liver and pancreas in individual colors using ^{198}Au and ^{75}selenomethionine. Characteristic scans have been obtained which differentiate a number of disease states from the normal pancreas and liver. The pancreatic and liver diseases studied and characterized are carcinoma of the pancreas, pancreatic insufficiency, acute recurrent pancreatitis, pancreatic pseudocyst and Laennec's cirrhosis, hepatoma and metastatic malignancy in the liver. The uptake of ^{75}selenomethionine in malignant lesions in many instances produces positive scans of these tumors in contrasting color to the liver. Depth discrimination in color with the two-probe system has permitted the lateralization of intracranial lesions, the color of the display being proportional to the depth of the lesion. The discrimination of depth and gamma-ray energy by dual-channel color scanning and its general application in visualizing other organs has been accomplished. (auth)

33451 DESIGN AND CONSTRUCTION OF A MULTI-SLIT COLLIMATOR AND A FOCUSED COLLIMATOR FOR A 127-MM-DIAMETER CRYSTAL. Gongora, R.; Gandy, A.; Gongora, G.; Jammet, H.; Lemarquand, G. (Fondation Curie, Paris). pp 217-34 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969. (In French).

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Collimation methods inherent in the so-called profile method are described. It is shown how a conventional slit collimator can be modified to improve performance, particularly for deep tumors. This led to the design of a multi-slit collimator linked with a large diameter crystal for scintigraphy. It is concluded that the collimation factor can be significantly improved. This justifies the use of large-size crystals for conventional scintigraphy and profile tracing. (auth)

33452 MULTIPLANE TOMOGRAPHIC GAMMA-RAY SCANNER. Anger, H. O. (Univ. of California, Berkeley). pp 203-16 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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With this new instrument, high resolution over a wide range of depths is combined with the high sensitivity of conventional large-crystal gamma-ray scanners. In contrast to conventional scanners, which produce a single picture having sharpest resolution at the geometric focal plane of the collimator, this new scanner will produce five or more pictures which sharply resolve activity near five or more planes spaced at intervals throughout the organ being scanned. In each picture, activity lying on or near a selected plane is shown in sharp focus, while activity lying at other depths is superimposed but blurred, as in x-ray tomography. The instrument applies principles from the scintillation camera to focused-collimator gamma-ray scanners. It consists essentially of a gamma-ray image detector as used in the scintillation camera (except for having a thicker scintillator and a smaller number of phototubes), a focused collimator, and a special optical readout camera. While the gamma-ray image detector scans the subject in the same manner as a conventional rectilinear scanner, the film in the optical readout camera scans in synchronism. By the use of several lenses with graded focal lengths, five or more pictures, each resolving a different plane within the subject, is obtained from a single cathode-ray tube display of the photopeak scintillations occurring in the image detector. A digital memory and display system can be used in place of the optical readout camera to obtain both visual displays and numerical data. (auth)

33453 MULTIFUNCTION DIGITAL RESEARCH SCANNING SYSTEM. Smith, E. M.; Katchis, L. Jr. (Univ. of Miami, Fla. Mount Sinai Hospital, Miami Beach, Fla.). Contract AT(40-1)-3734. pp 187-202 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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The multifunction digital research scanning system is a modularly constructed organ visualization system. The design objective of this system is quantification of organ visualization data, i.e., μCi/g. It is a high-speed (500 cm/min), 14-crystal, digital rectilinear scanner built as a special-purpose hard-wired computer. The two synchronous detector heads, one beneath and one above the scan table, each consist of a linear array of seven, 3-in. × 2-in. NaI(Tl) crystals, each crystal having its own focused collimator. Each 7-detector array can be independently moved in the vertical direction. The exact position of the detectors is known at all times by the use of an absolute 13-bit shaft angle encoder along the longitudinal axis of the scan table and a programmable SloSyn motor across the table. Anatomical landmarks may be programmed into the system and automatically recognized when the detector passes over these points. The scan field is 198 cm long by 62 cm wide with a position resolution of 0.14 cm. The primary scan motion is along the longitudinal axis of the table and the detectors are indexed across the table. The scan image is built up seven lines at a time, allowing the total scan field to be visualized with each pass of the detectors. Each crystal has its own 8-bit or 12-bit counter with buffer storage. A single fast pulse-height analyzer (200 nsec. random pulse-pair resolution) is used for all 14 crystals using a time-sharing "cueing" technique. The major components' of the system consist of the mechanical scanning frame and position encoders; radiation detectors, coincidence circuitry and nuclear instrumentation; counters and buffer storage; anatomical landmark recognition section; arithmetic section; program control logic, system control logic; output control logic and the output devices. At present, the output devices consist of digital cathode-ray tubes, a storage scope, an IBM I/O writer and a Kennedy incremental read-write magnetic tape recorder. This system has been designed to perform a variety of quantitative clinical procedures. These studies include isosensitivity scanning, dual radionuclide scanning, whole-body and linear profile counting, positron scanning and dynamic function studies. (auth)

33454 DYNAPIX: A NEW CONCEPT IN RAPID RECTILINEAR SCANNING. Verdon, T. A. Jr.; Allen, F. H. (Letterman General Hospital, San Francisco). pp 177-86 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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The Dynapix is a machine that has been developed to produce high-quality rectilinear scans in a very rapid time sequence. Ideally, all the favorable qualities of rectilinear scanning would be performed in a time frame comparable to that of the sctinillation camera. To obtain this result this machine is composed of two parts: a detector head which has ten sodium-iodide crystals and their component parts moving in unison, and a console that records the data from this detector head on television, magnetic tape, and polaroid film simultaneously. This machine was used in the study of 1000 patients for a total of 3000 scans. It has proven to give high-quality scan images and diagnostic information in minutes. A review of the first 1000 patients studied, and their scans produced by this machine, is discussed and selected examples of various scans are shown. Comparative studies obtained on patients studied the same day on both the Dynapix and a scintillation camera (Pho/Gamma) are displayed, and the characteristics of each machine are compared. (auth)

33455 NEW DEVELOPMENTS IN POSITRON SCINTIGRAPHY AND THE APPLICATION OF CYCLOTRON-PRODUCED POSITRON EMITTERS. Brownell, G. L.; Burnham, C. A.; Wilensky, S.; Aronow, S.; Kazemi, H.; Strieder, D. (Massachusetts General Hospital, Boston). pp 163-76 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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A hybrid positron scanner has been constructed and is undergoing tests for brain tumor localization using ^{74}As. The scanner uses two rows of detectors each containing 9 NaI scintillators and phototubes. The detector array moves continuously in the horizontal direction and in steps in the vertical direction, producing a scintigram with no line structure. The data are recorded on tape for replay or for computer processing. In either case, the plane of best focus can be positioned at will. The techniques developed for the hybrid scanner will be used in a stationary device employing two two-dimensional arrays of detectors. The design will emphasize the very rapid collection of data and the sequential production of scintigrams. The advantages and techniques of positron annihilation detection are also applicable to devices for study

of dynamic function. A fast six-detector coincidence system for pulmonary function studies is described. The measurement of time-of-flight offers the possibility of three-dimensional visualization of a distribution of positron-emitting radioisotope. Systems with resolving times as small as 0.3 nsec, corresponding to a spatial resolution in the third dimension of about 5 cm, are being studied. The problems of incorporating time-of-flight techniques into scanning and dynamic function devices are being evaluated. (auth)

33456 THE MAGNACAMERA, AN IMAGE-INTENSIFIER RADIOISOTOPE CAMERA. Ter-Pogossian, M. (Washington Univ., St. Louis). pp 151-9 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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The Magnacamera is a radioisotope camera using as a detector a specially designed high-gain image intensifier tube with a cesium iodide input screen. The tube is optically coupled to an intensifier image Orthicon television chain. The video signal supplied by the Orthicon is simultaneously recorded on video tape and displayed on television monitors. In addition to video tape recording, the results of the examination can be recorded by means of a Polaroid camera, a 35-mm camera, or a cine camera. The results of the examination can also be quantized. The advantages of this camera are: high-resolution, capability of handling data rapidly, and conversion of the image obtained into a video signal which allows contrast manipulation and quantization. The main disadvantages of this design are: low efficiency of this system for the detection of photons with energy above 200 keV, and absence of pulse-height discrimination. (auth)

33457 METHOD FOR ADJUSTING THE ANGER CAMERA. Oberhausen, E.; Neumann, K. J.; Schiffler, W. (Univ., Saarlandes, Homburg, Ger.). pp 145-50 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

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The uniformity of the Anger camera is a basic condition for the interpretation of scintiphotos and its importance increases with the accuracy of the evaluation method used for the interpretation of the scintiphotos. This is especially true for the use of three-dimensional multichannel-analyzers with quantitative data output. With the standard method, used until now, all photomultipliers are tuned to give the same count-rate when the crystal close to the center of each photomultiplier is irradiated by a collimated source. If thereafter the crystal is irradiated by a uniform flux of gamma rays, the density of the dots increase from the center of the scintiphoto towards the outer edge. This means that uniformity has not been achieved. In clinical use hot spots would be simulated for those parts of an organ that are visualized at the outer part of the crystal. By using the magnetic core memory of a multichannel analyzer for quantitative evaluation of the scintiphotos, we developed a method by which the photomultipliers are tuned with respect to their geometrical position. Thus, it is possible to achieve a uniformity within a few percent over the whole crystal. The method and its theory are discussed. Data for the resolution of the Anger camera after this tuning process are given. (auth)

33458 COMPARATIVE INVESTIGATIONS WITH THE ANGER SCINTILLATION CAMERA AND THE DIGITAL AUTOFLUOROSCOPE. Lorenz, W. J.; Schmidlin, P.; Kampmann, H.; Ostertag, H.; Adam, W. E.; Arnold, H.; Maier-Borst, W. (Deutsches Krebsforschungszentrum, Heidelberg). pp 135-44 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

The performance of a Nuclear-Chicago Pho/Gamma II scintillation camera was compared with that of a Baird-Atomic model 5000 digital autofluoroscope. The intrinsic resolution, the overall resolution, and the sensitivity of both camera systems were measured in the gamma-ray energy range between 0.1 and 1.0 MeV. In addition, comparative measurements with the IALA liver-slice phantom and functional studies with animals were performed. The data from these measurements were evaluated in analog and digital form for both systems. The investigation showed that the overall resolution of the two cameras is about equal and amounts to about 10 mm in the most favorable cases. The sensitivity of both systems is about 10^{-3}. The quality of the analog and digital scintigrams of the two cameras is compared. (auth)

33459 IMPROVED PULSE ARITHMETICS FOR A GAMMA CAMERA SYSTEM. Svedberg, J. B. (Uppsala Univ.). pp 125-34 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

The performance of gamma-ray cameras of the Anger type with different pulse mixing methods were compared by computer methods. The alternatives tested comprise the original Anger pulse mixing method, a modified version with adjusted weighing factors and three versions of "ratio" mixing. The latter include the method proposed by Mallard and Myers and two new variants in which the denominator pulse and the energy defining pulse are generated separately. It was found that one of the latter versions gives an image with less distortion than that obtained by the other methods. The influence on the resolution of the stochastic variation in the production of photoelectrons was also studied for the different pulse mixing methods and the modified "ratio" mixing methods appeared to yield a better resolution. (auth)

33460 RESOLUTION COMPONENTS AND DIFFERENTIAL LINEARITY OF A GAMMA CAMERA. Larsson, E. I.; Liden, K. (Univ. of Lund, Sweden). pp 111-23 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

This paper evaluates the different factors contributing to the overall resolution distance in a gamma-ray camera (Nuclear-Chicago Pho/Gamma III). Collimator contribution is compared with the inherent resolution. The increasing interest in radionuclides emitting low-energy gamma rays that are easier to collimate and are absorbed almost 100% in a 12.7-mm-thick NaI(Tl) crystal, makes it imperative to study how the statistical contribution from the photomultiplier tubes affects the resolution. Digital registrations of narrow-beam and line-source response functions have been made to study the inherent and overall resolutions. Resolution distance is defined as full width at half maximum (FWHM) of these functions and can be measured with great accuracy in this manner. For the inherent resolution this is done at gamma-ray energies from 27 to 514 keV. Overall resolution is measured at 140 keV with the pinhole collimator and with the low-energy lead collimator (4000 holes, 4.4-cm thick), and at 360 keV with the medium-energy lead collimator (1000 holes, 7.6-cm thick). Irregularities in line-source response functions at different distances from the multichannel collimator are studied in detail. With accurately adjusted window-correction circuitry, inherent resolution is shown to be independent of window width but dependent upon position over the useful detector area. The concepts of number distortion and true differential linearity are discussed and documented by experimental results. (auth)

33461 IMAGE FORMATION BY ELECTRONIC CROSS-TIME CORRELATION OF SIGNALS FROM ANGULAR RANGES OF UNFOCUSED COLLIMATING CHANNELS. Cassen, B. (Univ. of California, Los Angeles). Contract AT(04-1)GEN-12. pp 107-10 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

As shown by Anger it is theoretically possible to scan in focus several sections in depth simultaneously with a focused collimator. Focused images are formed from what would ordinarily be smeared-out images by means of an optical system with moving components. A general theoretical formulation applicable to many other methods of image reconstruction is presented. To illustrate, counts are recorded on tape from individual collimating channels while an array of such channels, all at different angles and azimuths from the vertical, scans a three-dimensional distribution of a gamma-emitting radioisotope. By superimposing tape playback at suitably displaced relative times a focused image can be presented for a plane at any depth or at any angle. The cross-time correlations can be done so rapidly that a focused three-dimensional image of the original distribution can be displayed. It is not necessary that all the collimating channels focus to a common point. The relaxation of this requirement enables some novel collimator system designs. The signal from an individual collimating channel must be separately identifiable either by means of small individual detectors or by co-ordinates of the scintillations in a slab crystal by the methods used in the well-known scintillation camera. However, in the case under consideration the co-ordinate does not represent actual position in an image. (auth)

33462 BRAIN IMAGING WITH THE SPINTHARICON. Forsaith, Ann L.; Horwitz, N. H.; Lofstrom, J. E.; Izenstark, J. L.; Cook, K. J. (William Beaumont Hospital, Royal Oak, Mich.). pp 99-106 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

The spark imaging camera has been successfully applied to the imaging of the distributions of radioactive ^{125}I in the thyroid gland. A 7-in.-diameter chamber has been developed for use with larger organs. In experiments with skull phantoms, high-resolution images have been obtained with focal areas of 2.2 cm in diameter containing as little as 30 μCi of ^{99m}Tc-labelled sodium pertechnetate at a distance as great as 10 cm from the face of the collimator. In its present form, the Spintharicon is not adaptable to electronic discrimination of photon energies. An electronic quenching circuit aids in increasing the count-rate with the high fluxes that can be obtained in ^{99m}Tc brain imaging. The contrast obtained in the image is controlled by the film contrast and camera f-stop. By using high-contrast copy film instead of the conventional ASA 3000 type, areas of increased activity are more easily visualized in a background pool of radioactivity. In these large distributions spark contents ranging from 30,000 to 60,000 are usually required for adequate resolution. In-vivo demonstrations of known brain lesions have been obtained with the Spintharicon. In its present stage of development, the inability to enhance contrast may limit its clinical usefulness in situations where the target to non-target ratio is low. (auth)

33463 STATIONARY GAS DETECTOR AND A NEW TYPE OF GAMMA CAMERA. Lansiart, A.; Lequais, J.; Roux, G.; Morucci, J. P.; Gaucher, J. C. (CEN, Saclay, France). pp 87-98 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969. (In French).

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

Studies carried out by the Electronic Physics Section at Saclay on different techniques for use in conjunction with spark and cascade chambers are described. These detectors are mainly filled with xenon. A system of three plane electrodes forms two cavities: the larger one forms the detection chamber, the other, smaller in size, the electron amplification chamber. A transparent semiconducting deposit on glass limits the current in the sparks; a shunt placed at the edge of the amplification chamber still further reduces the amount of energy released into the gas. Operation is improved by choosing as organic vapor a gas with an ionization potential close to the first excitation level of xenon (in this case diethylamine). The first commercial model is demonstrated. The shunt has also been adapted for cascade operation, but here a cascade signal preamplifier is attached to the grid. Finally, a new anode structure is shown, consisting of a stannic oxide deposit broken down into 20 areas with the shunt being suppressed. Each area has its own dead time, thereby lowering the detector dead time. The second part of the paper deals with a new method of recording scintillations produced in a NaI(Tl) crystal. The crystal, or crystal mosaic, is placed against the window of an amplifier tube which serves as an image reducer (input diameter 200 mm, output diameter 25 mm). Four photomultipliers transpose the scintillation position onto the output screen. (auth)

33464 A SEMICONDUCTOR GAMMA CAMERA WITH QUANTITATIVE OUTPUT. PRELIMINARY RESULTS. Parker, R. P. (Inst. of Cancer Research, Sutton, Eng.); Gunnersen, E. M.; Wankling, J. L.; Ellis, R. pp 71-85 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

Recent advances in semiconductor nuclear radiation detectors have made possible the development of a gamma camera consisting of an array of Ge(Li) detectors suitable for use with low-energy gamma rays. Such detectors possess high-energy resolution and energy is transferred directly from the incident photon to electron-hole pairs and thence to the output pulse without the need for any intermediate optical stages. After a brief review of the operation of such devices the method of constructing, mounting, and making the contacts to the array is described. One approach is to make the array from elements of approximately 2 mm × 2 mm × 1 cm high with a common back contact and connect them to a separate matrix of preamplifiers sufficient in gain to provide pulses suitable for subsequent data processing. Each element has high-energy resolution of ~4 keV. The common pp^+ contact of the detectors is connected to a low-noise, charge-sensitive preamplifier for high-energy resolution pulse-height analysis, the output pulse from the analyzer being used to gate the amplifier matrix. This method reduces the number of high-quality preamplifiers required while retaining the benefits of good energy resolution. A more promising method, which further reduces the number of amplifying channels, and thus the cost, is to arrange parallel strip contacts on the front and back surfaces of the detector so that their directions are orthogonal. This technique is considered in detail, and for small arrays experimental results are given for energy resolution, positional definition and cross-talk between adjacent detector elements. (auth)

33465 TRANSMISSION SCINTIPHOTOGRAPHY AND ITS APPLICATIONS. McRae, J.; Anger, H. O. (Univ. of California, Berkeley). Contract W-7405-eng-48. pp 57-69 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

Clear transmission pictures were obtained of the heart, diaphragm, trachea, and the lungs in both PA and lateral projections, using the scintillation camera and a radioactive source on the opposite side of the patient. Gas within the stomach and bowel is visualized, and contrast media is readily seen in the intestine. The use of transmission scanning with a rectilinear scanner as a means of improving the interpretation of radionuclide emission scans has been reported previously by Kuhl et al., and it has also been used by Anger in the Whole Body Scanner Mark II. To take transmission images with the scintillation camera, a conventional multichannel collimator is placed on the camera and a radioactive disc source 11 in. in diameter is placed underneath the patient. A second multichannel collimator is placed on top of the source to reduce the radiation dose to the patient. It also reduces the amount of scattered radiation that appears on the pictures. If the disc source contains about 10–20 mCi of ^{99m}Tc, transmission pictures can be taken in 1–2 min. The patient receives less than 1 mR/h to a limited area of the body and virtually no irradiation elsewhere. Transmission pictures can be used in positron-camera studies. Instead of a disc source, a radioactive point source is placed at the same distance from the image detector as the positron-camera focal detector crystal. No collimators are used. Transmission scintiphotos are then obtained that have the same magnification as the positron emission pictures. (auth)

33466 NEW SCINTILLATION CAMERA. Thomas, F. D. (Univ. of Michigan, Ann Arbor); Beierwaltes, W. H.; Knoll, G. F.; Jones, L. W.; Colvin, T. H.; Colestock, H. E. pp 43-56 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

The basic device consists of a 9 × 1-in. NaI(Tl) crystal, objective lens, three-stage image amplifier, transfer lens and a photographic readout. Various multichannel and pinhole collimators were designed. This system was not clinically useful because of a poor signal-to-noise ratio (i.e., a noisy image tube). Revisions in the second model include: (1) more efficient multihole collimators designed for a maximum gamma energy of 200 keV and resolutions of 10 to 28 mm at 10 cm distance; (2) a new objective lens system with 48% transmission efficiency for NaI light; (3) a new three-stage image amplifier tube with bi-alkali photocathode surfaces and significant noise reduction; (4) improvements in the photographic readout so that various film types can be used; and (5) parallel development of an orthicon video system which will allow readout of the image directly from the output phosphor. Currently, mechanical redesign and modifications are in progress. Evaluation of this device with phantoms indicate that it will be clinically useful; concentrations of 10 μCi of ^{99m}Tc in a thyroid phantom can be visualized with 10 minutes of integration time. This represents a hundred-fold increase in signal-to-noise ratio from the previous device. Clinical studies are reported as well as a first assessment of the video readout. (auth)

33467 THE IMAGE INTENSIFIER SCINTILLATION CAMERA AND SINGLE-CRYSTAL CAMERA. A COMPARATIVE EVALUATION. Freedman, G. S. (Columbia Presbyterian Hospital, New York); Goodwin, P. N.; Johnson, P. M.; Pierson, R. N. Jr. pp 31-42 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

The newly developed Ter-Pogossian image intensifier scintillation camera and the single-crystal camera introduced earlier by Anger represent two new and different systems for imaging radioactive events in man. An objective evaluation of both camera systems with comparisons of their major distinguishing parameters in static and dynamic scanning situations is presented. Static evaluation included: field uniformity, resolution, field linearity, sensitivity and image deterioration due to scatter. An energy range from 35 to 365 keV was evaluated for both systems. Isotopes included in the evaluation are: ^{125}I, ^{197}Hg, ^{99m}Tc, ^{203}Hg, and ^{131}I. Moreover, a transfer function was determined for each system using the Siemen's Star phantom and the systems compared in this way. To a limited extent a dynamic evaluation was undertaken to determine speed, resolution, information recording, storage and display for both systems. The relative advantages and disadvantages of both commercially available systems are

presented and certain modifications to improve their clinical usefulness are discussed. (auth)

33468 A MULTISTAGE IMAGE INTENSIFIER GAMMA CAMERA AND RADIOISOTOPE ANGIOGRAPHY. Iio, M. (Tokyo Univ.); Ueda, H.; Sasaki, Y.; Sugishita, Y.; Kumano, N.; Kurihara, S.; Kashiwazaki, M.; Miyashiro, S. pp 17-29 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

A new and simple gamma-ray camera is presented which was introduced by the authors in 1967. It consists of an 11.5-in.-diameter NaI(Tl) crystal coupled optically through a lens system to a specially developed ultrasensitive image intensifier tube (Toshiba multistage image tube M-7064-A). The latter has a gain in light flux of 10^4 to 10^5 at its output screen compared with the incident light from the scintillation crystal. This light multiplying process is then repeated by an additional image intensifier tube resulting in a total gain of 10^8 to 10^{10}. Thus, each gamma ray that interacts with the crystal produces several thousand photons at the output screens of the second tube which are recorded on videotape for further analysis. The gamma camera is used mainly for the 140-keV gamma rays of ^{99m}Tc with a 4681-hole tungsten collimator. Its sensitivity is 110 dots recorded on the film per minute with a 1 μCi ^{57}Co source; its resolution is 10 mm at the surface of the collimator. No dead-time problems exist for the camera even for large amounts of radioactivity administered to the patient. Pulse-height selection is presently being incorporated which should yield a better resolution by excluding a major fraction of the scattered radiation from detection. Radioisotope angiography is one of the most promising applications of this gamma camera. Exploratory studies have been performed on patients with various pulmonary disorders and some control subjects. (auth)

33469 THE ABER-GAMMASCOPE. AN IMAGE INTENSIFIER GAMMA CAMERA. Mallard, J. R.; Wilks, R. J. (Univ. of Aberdeen, Scotland). pp 3-16 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

A novel gamma imaging device is described which utilizes a high-gain image intensifier to view the scintillations in a flat circular crystal by means of a specially constructed lens system. The maximum diameter of crystal (CsI(Na)) viewed at present is 14 in., with a thickness of $\frac{1}{4}$ in. Pictures produced with an 8-in.-diameter crystal are shown. The system gives a sensitivity as good as an Anger camera if it is used with the same collimator. The highest sensitivity refers to gamma-rays for about 200 keV energy. The inherent resolution of the system (i.e., not including the collimator) is less than 1 mm and the amount of light focused onto the photocathode by the lens system is about 2% at 4:1 demagnification. At present, the resulting picture is integrated by a camera with an open shutter, but a closed-circuit television system is now being investigated. Although the device images all types of absorption events in the crystal onto the photocathode in their correct relative positions (and independent of energy of event), it is thought desirable to be able to switch the tube on only when required, i.e., for those events corresponding to the photopeak. This is not only to lessen the deleterious effects of Compton events on the overall resolution (which are in any case biased against visually since they are less bright, on average, than photoevents), but to reduce the effect of high-energy cosmic-ray noise in the crystal, which is the biggest degrading factor. The limitation of sensitivity imposed by a collimator of given resolution may be offset by using a coarser resolution collimator and subsequent modification of the information. This has been successfully achieved, resulting in a gain of sensitivity for a given resolution of between 3 and 4 times. Pictures are shown of the resulting performance. (auth)

33470 COMPUTER-ASSISTED PARATHYROID SCANNING. Keeling, D. H.; Todd-Pokropek, A. E. (Middlesex Hospital Medical School, London). pp 745-57 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

Recorded cases and series of selenomethionine scans of parathyroid adenomas show a preponderance of positive scans with comparatively large tumors, whereas it is the small adenomas which give the most difficulty to the surgeon. Considerable difficulty is encountered locating small functioning adenomas of the parathyroid glands by normal scanning procedures using ^{75}Se–selenomethionine. A digital data collection device was developed which outputs the scan on paper tape for computation. The two operations of "smoothing" and "dot shifting" are performed simultaneously in the computer, the composite operation being iterated. Although these operations are opposed in being respectively gradient decreasing and enhancing, the composite operation is reasonably stable. Unlike unfolding or matrix inversion techniques for scan processing, a suitable output is obtained after two or three iterations. The results of the computer procedure are presented for a series of normal cases and eleven patients with suspected hyperparathyroidism, none of whom had a palpable mass in the neck. In particular, the background pattern of selenomethionine uptake in the neck and superior mediastinum, against which a parathyroid adenoma is sought, is described. This pattern also varies with time. Thyroid uptake is always discernible even after "suppression" by tri-iodothyronine, 40 μg t.d.s. for a week, and the pattern of remaining uptake is often patchy and asymmetrical. It is possible to inspect the scan in the computer, to recognize the "normal" pattern, and to search for aberrations. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 34916–34918 and 34924.

33471 (AD-680817) ELECTROSTATIC SPECTROMETER FOR MEASURING THE PROTON RECOIL SPECTRUM IN NEUTRON BETA DECAY. Kubischta, Werner (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Institut). June 25, 1968. Contract AF61(052)-857. 80p. (In German). (AFOSR-69-0039-TR). CFSTI.

Part of the work for an experiment on neutron decay, in which the coefficient of the electron-antineutrino angular correlation is to be determined from a precise measurement of the shape of the proton recoil spectrum is described. Since a resolution 2 percent and a small entrance aperture for the adjacent detector was required and in view of the low proton energy (752.34 eV maximum), the time-of-flight spectrometer was chosen. Numerical methods were used to determine the smallest possible condensor dimensions, considering the large cross section (38 mm) of the entering proton beam, and taking the fringing field into account. The mesh method was used to calculate the potential near the electrode edges, and the Runge-Kutta-method was used to calculate particle orbits. The minimum central particle orbit necessary is shown to be 300 mm. A hydrogen ion source, consisting of an electron impact source and a Wienfilter, has been used to test the spectrometer. Excellent agreement between measured and calculated particle orbits was found. (USGRDR)

33472 (ANL-7282, pp 89-102) BENT-CRYSTAL SPECTROMETERS. Schult, O. W. B. (Brookhaven National Lab., Upton, N. Y. Technische Hochschule, Munich (West Germany)).

The design characteristics and application of crystal spectrometers for neutron-capture gamma spectroscopy are described. Two types of instruments, focusing devices and flat crystal spectometers are examined. The automation of the Riso curved-crystal spectrometer in order to reduce the errors due to source movements is discussed. Finally, a few remarks are presented on the crystal size in DuMond-type spectrometers for (n,γ) measurements. (B.G.D.)

33473 (ANL-7282, pp 118-87) PRESENT STATUS OF THE DEVELOPMENT OF Ge(Li) SPECTROMETER SYSTEMS AT ARGONNE. Mann, H. M. (Argonne National Lab., Ill.).

The development of Ge(Li) spectrometers at Argonne National Laboratory is discussed. Topics include the Ge(Li) detector including a simple physical description; preparation and dual-drift and thin-window detectors; cryostats; Ge(Li) spectrometer design including the charge-sensitive section, output amplifier, pulse shaping, amplifiers, threshold (biased) amplifiers, multichannel analyzers, pulse generators, and present limitations and new areas; and details on spectrometer performance. (B.G.D.)

33474 (ANL-7282, pp 233-44) AUTOMATIC ANALYSIS OF SPECTRA FROM Ge(Li) DETECTORS. Mariscotti, M. (Brookhaven National Lab., Upton, N. Y.).

A method is described for the automatic analysis of gamma spectra from Ge(Li) detectors. The data are recorded on magnetic tape. A program was developed to read the tape and find the peaks and set the required parameters to link automatically into a least-squares fitting program. (J.W.R.)

33475 (ANL-7282, pp 279-85) SUPERCONDUCTING INTERNAL-CONVERSION-ELECTRON SPECTROMETER. Burson, S. B. (Argonne National Lab., Ill.).

A superconducting internal-conversion electron spectrometer is described which consists of target chamber, Dewar, Si(Li) detector for detection of conversion electrons in coincidence

with a Ge(Li) detector for gamma radiation, and a magnet which focuses the electrons to the Si(Li) detector. (B.G.D.)

33476 (ANL–7282, pp 427-39) USE OF A FAST CHOPPER IN RESONANCE-NEUTRON-CAPTURE GAMMA-RAY STUDIES. Cote, R. E. (Argonne National Lab., Ill.).

The types of measurements that can be made with fast choppers in neutron-capture γ spectroscopy are described. Some of the advantages and disadvantages of systems containing choppers are discussed. (J.W.R.)

33477 (CEA-CONF-1249) α AND γ SPECTROMETRY PRESENT STATE: FUTURE PERSPECTIVE. Pascal, A. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan. 28, 1969. 33p. (In French). (CONF-681051-1). Dep.

From Conference on Phyrama, Marseille, France.

The detection techniques used for α and γ spectrometry are briefly outlined and properties of these radiations are reviewed. For fine structure α spectrometry grid ionization chambers and surface barrier semiconductors (semiconductor detectors) are the only two detectors presently used. Examples are given of the application of these detectors. In γ spectrometry NaI(Tl) scintillators have been largely supplanted by Ge(Li) semiconductor detectors. Examples are given of the use of these detectors. Possible future developments in the detection of these two radiatfons are discussed. (J.S.R.)

33478 (EUR–4240) SPECTRAL PERFORMANCE OF A Ge(Li) PULSE HEIGHT SPECTROMETER AT HIGH EVENT RATES. Meyer, H.; Vereist, H. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau). Dec. 2, 1968. 12p. Dep.

For γ-ray spectroscopy with Ge(Li) detectors high event rates are often desirable, not only for their application in coincidence experiments but also because of the presence of large Compton background. Modern instrumentation techniques were applied and a fast servostabilized pulse height converter has been used for the measurement of γ-ray spectra up to event rates of 300 kHz. The features of the spectrometer are described and performance limitations are discussed. Limitations are introduced especially by the detectors, if high peak-rate-to-peak-width ratios are desired. (auth)

33479 (TUBIK–11) DETERMINATION OF THE THERMAL SPECTRUM OF THE SUR 100 BE WITH A CRYSTAL SPECTROMETER. Bartsch, G.; Seifert, W.; Wesser, U. (Technische Universitaet, Berlin (West Germany). Institut fuer Kerntechnik). Oct. 1968. 143p. (In German). Dep.

The measurement of the thermal neutron spectrum by a lithium fluoride crystal spectrometer for a zero power reactor (SUR 100 BE) is described. Operational equations and error factor calculations are presented. The experimentally observed neutron temperature agrees well with theoretically estimated values within the experimental inaccuracies. (auth)

33480 STABILIZATION SYSTEM FOR A MULTIDETECTOR SCINTILLATION SPECTROMETER. Mangoryanov, V. V.; Oganesyan, K. O.; Omel'yanenko, M. N.; Fil'chenkov, V. V.; Khulubei, V. (Joint Inst. for Nuclear Research, Dubna, USSR). Prib. Tekh. Eksp., No. 2, 76-81(Mar.-Apr. 1969). (In Russian).

A stabilization system for multidetector scintillation spectrometer is described. The source of calibrated signals is provided by GaP electroluminescent diodes. The system is synchronized with a synchrocyclotron. The stabilization of the intensity coefficients of all channels is realized between the pulses from the accelerator. The accuracy of stabilization is determined by the stability of the calibrated signals and constitutes about 1%. The stabilization system described is for a scintillation neutron spectrometer with nine detectors, designed for use in experiments for studying muon capture by light nuclei. (tr-auth)

33481 GERMANIUM GAMMA SPECTROMETER. Degtyarev, Yu. G.; Protopopov, V. N. Prib. Tekh. Eksp., No. 2, 33-7(Mar.-Apr. 1969). (In Russian).

The procedure for compensation of acceptor impurities in Ge by drifting Li ions at 56°C is described. The design characteristics of the cryostat for the operation of the detector at liquid nitrogen temperatures are given. The energy resolution for the gamma peak from ^{170}Tm (E_γ = 84.3 keV) is 4.1 keV. The spectra from ^{170}Tm, ^{51}Cr, ^{131}Cs, ^{46}Sc, and ^{60}Co were measured. (tr-auth)

33482 THE DETERMINATION OF THE SENSITIVITY OF A QUANTOMETER AT ENERGIES FROM 0.6 TO 1.5 GeV. Komar, A. P.; Kruglov, S. P.; Lopatin, I. V.; Mus, K. F.; Filimonov, E. A.; Grishaev, I. A.; Shramenko, B. I. (Physical-Technical Inst., Leningrad. Physical-Technical Inst., Kharkov). Prib. Tekh. Eksp., No. 2, 38-9(Mar.-Apr. 1969). (In Russian).

By means of comparison with calorimetric methods, an experimental investigation of the sensitivity of a quantometer filled with air and with 95% Ar + 5% CO_2 mixture in the energy range 0.6 to 1.5 GeV was conducted. There was observed a tendency for a decrease in sensitivity when $C = 1.34 \times 10^{-19}$ coulomb/MeV (±5%) and this coincides within the limits of error in calculations. The relation of the readings of the quantometer with air and the Ar–CO_2 mixture is about 1.5 and does not depend on E_γ. The conditions for saturation of ionization currents in the quantometer at different intensities were studied. (tr-auth)

33483 THERMOLUMINESCENT SPECTROMETER OF X AND GAMMA RADIATION. Kudelin, K. M. (Novosibirsk State Inst. of Measurement and Measuring Devices, USSR). Prib. Tekh. Eksp., No. 2, 200-2(Mar.-Apr. 1969). (In Russian).

The design characteristics of a spectrometer consisting of lithium fluoride thermoluminescent dosimeters for absorption spectrometry of x and gamma radiation are presented. Experimental results of x and gamma absorption measurements (both constant and pulsed) are included. (tr-auth)

33484 α-PARTICLE SPECTROMETRY WITH SEMICONDUCTOR DETECTORS. Hofker, W. K. (Inst. for Nuclear Physics Research, Amsterdam); Nienhuis, K.; Post, J. C. Philips Tech. Rev., 30: 13-22(1969).

The various special features of semiconductor detectors have led to their general use for the detection and energy measurement of charged particles (α- and β-particles, protons, etc.) and electromagnetic radiation (γ-rays); α-particle spectrometry is an appropriate example for illustrating the measurement technique. In α-particle spectrometry a good energy resolution and a low spectrum background are of paramount importance. In this respect the surface-barrier detector is the most suitable. Some special designs are described. It is shown that an approximate calculation of the energy resolution can be made. The spectrum background, which is attributable to many and various causes, is particularly high near to a high peak and makes it difficult to measure very low peaks near it. Special measures which can be used to improve the peak-to-background ratio considerably are described. At 400 keV below a high peak, it is now possible to obtain a ratio of 6000 : 1 (a ratio as high as 20,000 : 1 has been obtained with a special arrangement). The electronic measuring circuits required for α-particle spectrometry are combined with the vacuum chamber containing the radiation source and detector to form a single piece of equipment, the α-particle spectrometer. (auth)

33485 THEORETICAL AND EXPERIMENTAL STUDIES OF AN IMPROVED NEUTRON DECAY COINCIDENCE SPECTROMETER. Yang, Teh Li. Gainesville, Fla., Univ. of Florida, 1968. 130p.

Thesis.

The neutron decay coincidence spectrometer (NDCS) depends on the spectral analysis of the proton and beta particles that originate from neutron decay. A theoretical analysis of neutron kinematics was made and a computer program was developed to calculate the angular distribution of proton and beta particles in the CM system. The calculated proton flux from a 1/E neutron flux has a 1/E distribution also. A spectrometer was constructed which incorporates the following features: (a) a 4-inch magnet with stabilized power supply for mass analysis, (b) a vacuum chamber with provision for two detectors for coincidence measurements, (c) two solenoid containment magnets which increase the collection efficiency for protons by more than 30 per cent over that of the original spectrometer, and (d) a well-collimated neutron beam. The resolving power, $\Delta E/E$, of the NDCS for neutrons extracted from the UFTR beam port was slightly higher than the theoretical value due to spreading of the proton spectrum by the Au-Si surface detector and its associated electronics. The typical resolutions obtained were 0.52 ± 0.03 at 13.2 keV, 0.28 ± 0.02 at 30.2 keV, and 0.12 ± 0.01 at 95.3 keV. For reactor neutrons a 1/E neutron spectrum was obtained over an energy range from 10 to 30 keV with coincidence circuitry and for an energy range from 30 to 100 keV without coincidence circuitry. The total scattering cross section of aluminum was measured for neutron energies between 30 and 50 keV using the transmission method. (Disser. Abstr.)

33486 OPTIMALIZATION OF A SECTOR-FOCUSING MAGNETIC BETA-RAY SPECTROMETER. Van Krugten, H.; Koopmann, E. W. (Technische Hogeschool, Delft, Netherlands). Nucl. Instrum. Methods, 71: 280-4(1969).

The experimental procedures that are used to optimalize the focusing properties of a magnetic beta-ray spectrometer con-

taining iron are discussed. The window curve technique was used to shape the pole pieces. The exact focus forms were determined by photographs. The combination of these two techniques proved to be very efficient. Furthermore special attention is paid to the problem of scattering in the spectrometer. (auth)

33487 OPTO-ELECTRONIC FEEDBACK PREAMPLIFIER FOR HIGH RESOLUTION NUCLEAR SPECTROSCOPY. Goulding, F. S.; Walton, J.; Malone, D. F. (Univ. of California, Berkeley). Nucl. Instrum. Methods, 71: 273-9(1969).

A new type of preamplifier is described that promises a significant improvement in the energy resolution of semiconductor detector spectrometers. While other applications of the principles are anticipitated, their use only for x-ray fluorescence spectroscopy is discussed. A total electronic contribution to the resolution of about 150 eV (fwhm-silicon) with further small improvements considered likely in the near future was achieved. This includes the detector leakage noise contribution. A conventional system using components of the same inherent quality exhibits a resolution of nearly 300 eV. (auth)

33488 CONSTRUCTION AND TESTING OF A TIME-OF-FLIGHT SPECTROMETER FOR FAST NEUTRONS. Seeliger, D.; Truetzschler, K.; Wiesner, K. (Institut fuer Experimentelle Kernphysik, Pirna-Copitz, Ger.). Exp. Tech. Phys., 15: 341-51 (1967). (In German).

The construction of the electronic part of a time-of-flight spectrometer for neutrons for introduction into a pulsed neutron source was described. The time measurement is done by a time-amplitude conversion with a time resolution of $2\tau_0 = 1.25 \times 10^{-10}$ sec. The best resolution of the spectrometer for monoenergetic flash of light is $2\tau = 3 \times 10^{-10}$ sec. The spectrometer was tested with neutrons from the T(d,n)^{4}He nuclear reaction in a pulsed neutron generator. (tr-auth)

33489 APPLICATION OF CORRELATION TECHNIQUES TO ISOLATE STRUCTURE IN EXPERIMENTAL DATA. Black, W. W. (Idaho Nuclear Corp., Idaho Falls). Nucl. Instrum. Methods, 71: 317-27(1969).

A method is presented for automatically locating the structure, e.g., peaks, in experimental data through application of the cross-correlation function. Advantages of the method are simplicity, insensitivity of parameters, and a small number of parameters. To illustrate the versatility of this approach, example analyses are presented of data obtained with lithium-drifted germanium detectors, lithium-drifted silicon detectors, sodium-iodide detectors, and from neutron time-of-flight analyzers. Some comments are given on the general application of the method as it relates to automatic data analysis, particularly with on-line computers. (auth)

33490 GAMMA SPECTROMETRY ON THE BASIS OF GERMANIUM IRRADIATED WITH NEUTRONS. Kotina, I. M.; Meshcherskaya, L. I.; Novikov, S. R.; Rybkin, S. M.; Khusainov, A. Kh. Fiz. Tekh. Poluprov., 3: 623-5(Apr. 1969). (In Russian).

Germanium can be compensated by radiation defects in order to obtain stable gamma detectors. Moreover, the compensation need not be exact. In selecting the type of radiation it is important to obtain a uniform concentration of defects and it is important to know what effect the defects will have on the lifetime of the current carriers. Fast reactor neutrons, and a mixture of fast and slow neutrons were used for compensation. Fast neutrons were found to be ineffective, apparently because the lifetime of the carriers was lowered much more than with gamma irradiation. Irradiation of germanium with thermal neutrons led to the formation of gallium atoms, which introduce an acceptor into the forbidden zone. Hence, to prepare a gamma detector, n-type germanium having an initial impurity concentration of about 1×10^{13} cm^{-3} was irradiated in a mixed thermal and fast neutron flux. The irradiation time was selected so that the main part of the initial donors were compensated because of the introduction of gallium. Part of the radiation defects were annealed out in a nitrogen atmosphere at 300°C over a period of 60 to 70 hr. A gamma detector with a volume of 1 cm^3 and a cesium-137 resolution of 1.5% was prepared. Even better results could be obtained by combined irradiation with thermal neutrons and gamma radiation. (TTT)

High Energy Physics Instrumentation

Refer also to abstracts 34523 and 34534.

33491 (ANL-7515) PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON ADVANCED DATA PROCESSING FOR BUBBLE AND SPARK CHAMBERS [ARGONNE, ILLINOIS], OCTOBER 28-30, 1968. Royston, Richard J. (ed.) (Argonne National Lab., Ill.). [Jan. 22, 1969]. Contract W-31-109-eng-38. 496p. (CONF-681025). Dep. CFSTI.

Separate abstracts were prepared for thirty-two of the forty-four papers presented. Twelve papers were previously included in NSA. For abstract numbers of these papers see CONF 681025 in a cumulative report number index. (B.G.D.)

For abstracts of individual papers see: 33492–33523.

33492 (ANL-7515, pp 6-21) COCCINELLE: A DEVICE FOR AUTOMATIC PATTERN RECOGNITION AND EVENT MEASUREMENT ON BUBBLE CHAMBER PHOTOGRAPHS. Equer, B.; Guignard, C.; Reboul, G.; Volte, A. (College de France, Paris. Laboratoire de Physique Nucleaire).

The principle of the Coccinelle system which is based on analysis of bubble chamber photographs by successive approximations and is to be used mainly for scanning simple and frequent topologies (N prongs without neutral V) is discussed. The design and operating characteristics of the device are examined including spot generation, operating modes, control logic and computer connections, and correlation network. The strategy of the event recognition program is outlined. The state of the project is also briefly reported. (B.G.D.)

33493 (ANL-7515, pp 48-62) PRESENTATION OF BRUSH. PART I. BRUSH: AN ECONOMICAL SPECIAL-PURPOSE COMPUTER FOR ON-LINE HPD DATA PROCESSING, TRACK RECOGNITION, AND TRACK FOLLOWING. Billing, H.; Ruediger, A.; Schilling, R. (Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany)).

In this first of two papers on BRUSH, the overall concept is discussed. Details on hardware realization and on the simulation results are given in the BRUSH status report following this paper. A hardware solution to zero (or minimum) guidance on-line track recognition is proposed. The task of detecting track element candidates (in slices of 16 scan lines each) is solved by a two-parameter histogram technique. This is implemented by an array of 16 parallel shift register chains and 48 local processing units. Acceptance of track elements is made subject to certain confidence criteria. Accepted track elements are linked to form curved tracks. These allow tracks following into the next slice along narrow curved roads, and also a review into past slices to pick up track elements that may have been missed. The track element data, including bubble distribution, linkage information and confidence values are stored on tape for further processing in a special 3D geometry program. (auth)

33494 (ANL-7515, pp 63-80) PRESENTATION OF BRUSH. PART II. PRESENT STATUS OF THE BRUSH SYSTEM: HARDWARE REALIZATION AND SIMULATION RESULTS. Billing, H.; Ruediger, A.; Schilling, R. (Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany)).

The rather severe real-time requirements of the BRUSH system are met by distributed local processing units, by a fast central processing unit and by a program stored in a read-only diode matrix. The crucial hardware parts of the system have been tested successfully. The feasibility of the BRUSH concept has been tested extensively and successfully on a general-purpose computer. These simulations allowed an estimation of different search and discrimination strategies with respect to their efficiency in both recognition yield and CPU time. Yield and accuracy of track recognition are demonstrated by simulation results. Limitations of the system will be discussed. A special geometry program will have to be written to deal with the BRUSH output. Certain measures can be taken to relieve this geometry program of unnecessary reconstruction of beam tracks. (auth)

33495 (ANL-7515, pp 81-101) THE HARDWARE OF SATR. Thompson, Murray A. (Wisconsin Univ., Madison).

The SATR three-dimensional bubble chamber photograph analysis system is examined. The advantages of a three-dimensional analysis system are listed. The hardware for the SATR system is described, including the external 3D recognition hardware, and other circuit designs. (B.G.D.)

33496 (ANL-7515, pp 102-19) TRACK FOLLOWING WITH SATR. Morse, E. (Wisconsin Univ., Madison. Dept. of High Energy Physics).

The most important part of SATR is the three-dimensional pattern recognition system. This is a hardware device which is being constructed at the University of Wisconsin. The use of SATR hardware simulation programs is discussed and some of the problems and solutions encountered when following bubble chamber tracks in three dimensions are discussed. (auth)

33497 (ANL-7515, pp 130-9) FULL GUIDANCE MEASUREMENTS WITH THE CERN HPD 2. Blair, W. M. R. (European Organization for Nuclear Research, Geneva (Switzerland)).

The present situation of the CERN full guidance (or road guidance) system for the measurement of bubble chamber film is summarized. (B.G.D.)

33498 (ANL–7515, pp 140–63) THE NEW FSD–IBM 360/44 SYSTEM REALIZED AT C.N.A.F. AND ITS PERFORMANCES BOTH WITH ROAD AND MINIMUM GUIDANCE. Di Lazzaro, M. A.; Luvisetto, M. L.; Maggiolo, A.; Masetti, M.; Mignoli, A.; Romagnoli, U.; Venturi, D.; Zanotti, U. (Istituto Nazionale di Fisica Nucleare, Bologna (Italy). Centro Nazionale Analisi Fotogrammi).

The work at CNAF to analyze bubble chamber events by use of the FSD system is described. The actual work consists of three main items based upon our experience with the FSD-IBM 7094 system (analyzed experiment and ionization measurements). The first is the new FSD-IBM 360/44 system and its performance with road guidance programs. The second is analysis of events essentially using minimum guidance programs written for the FSD-IBM 360/44 system. The third is the application of the minimum guidance philosophy to the usual track following with road guidance programs. (auth)

33499 (ANL–7515, pp 164–72) THE HPD–CDC 3200 SYSTEM AT AMSTERDAM. de Boer, M.; van Dam, P. H. A.; Harting, D.; Holthuizen, D. J.; van Leeuwen, W. M.; Pfeiffers, R.; Snoek, C. (Amsterdam Univ. (Netherlands). Zeeman-Laboratorium).

The digitizing method, the hardware, and the software of the HPD-CDC 3200 system for analysis of bubble chamber film at Amsterdam are discussed. (B.G.D)

33500 (ANL–7515, pp 173–83) THE COBWEB DATA REDUCTION SYSTEM. Albrecht, Herbert C.; Binnall, Eugene P.; Birge, Robert W.; Myers, Myron H.; Weber, P. Wes (California Univ., Berkeley. Lawrence Radiation Lab.).

The Cobweb data reduction system, which is an on-line computer-controlled data analysis system designed to improve and increase the measuring rate of conventional track following Franckensteins and also to include checks on the output from scan tables, is described. (B.G.D.)

33501 (ANL–7515, pp 226–32) OPERATIONS ON-LINE TO A LARGE COMPUTER. Osborne, Carol (California Univ., Berkeley. Lawrence Radiation Lab.).

The TRIST multiprogramming system which was designed to coordinate computer use between the real-time Flying Spot Digitizer (FSD) programs and other data analysis programs is described. (B.G.D.)

33502 (ANL–7515, pp 233–43) THE USE OF THE ASI 6020 IN ON-LINE EXPERIMENTS AT ARGONNE. Akerlof, C. (Michigan Univ., Ann Arbor); Lales, J. (Argonne National Lab., Ill.).

The programming of an on-line experiment for the measurement of the reactor $\pi^+ + p \rightarrow K^+ + \Sigma^+$, using a system of wire spark chambers linked to an ASI 6020 computer by a SAC data buffer, is discussed. (B.G.D.)

33503 (ANL–7515, pp 244–55) TRACK FINDING, FOLLOWING, AND EVENT RECOGNITION ON POLLY. Loken, J. G.; Allison, W. W. M. (Argonne National Lab., Ill.).

Recent experience with the POLLY device which is basically an operator helped or operator linked system for analysis of bubble chamber film is discussed. (B.G.D.)

33504 (ANL–7515, pp 256–65) STUDY OF Σ LEPTONIC DECAY USING AN HPD IN A PATTERN RECOGNITION MODE. Newman, R.; Burd, D.; Franzini, P.; Garder, L.; Rabinowitz, G.; Teitelbaum, R.; Weinstein, G.; Feinman, J. (Columbia Univ., New York).

An automatic scan and measurement system is now in operation at Columbia University for the analysis of a Σ leptonic decay experiment. The nature of this system, which is based on an HPD with real time track following, has been described previously by Burd and Teitelbaum in Current Status of Automatic Scanning at Columbia University at the International Conference on Programming for Flying Spot Devices, Munich, January (1967). The system is briefly described here and the results of its application to a particular experiment are discussed. (auth)

33505 (ANL–7515, pp 266–74) MEASUREMENT OF THE K_1^0 DECAY BRANCHING RATIO USING AN HPD DEVICE IN THE PATTERN RECOGNITION MODE. Baltay, C.; Brod, M.; Burd, D.; Cooper, W.; Garder, L.; Rabinowitz, G. (Columbia Univ., New York).

A bubble chamber experiment the K_1^0 branching ratio $R = [(K_1^0 \rightarrow \pi^+\pi^-)/(K_1^0 \rightarrow \pi^0\pi^0)]$ is in progress using the Columbia University Hough–Powell Device operating in the pattern recognition mode. No prescanning or predigitizing was done on the film before the HPD scan. The experiment is now in production on the HPD; approximately 100,000 frames have been processed to date. A careful evaluation of the first 10,000 frames indicates that the system is performing in a very satisfactory manner. (auth)

33506 (ANL–7515, pp 275–98) DAPR: DIGITAL PATTERN RECOGNITION APPROACHES PRODUCTION. White, Howard S.; Britton, Barbara; Franz, Joan; Gee, Wen-Sue; Hall, Dennis; Jontulovich, Nan; Windorski, Frank (California Univ., Berkeley. Lawrence Radiation Lab.).

DAPR is a system which has been developed at Lawrence Radiation Laboratory for Digital Automatic Pattern Recognition in bubble chamber pictures. Pictures are measured by the Flying Spot Digitizer, and the data are reduced to yield a data abstract tape. This tape has, for each track found within each picture, precision points representing its locus, and a measurement of bubble density. The tape also has a short table specifying the spatial vertices and their constituent tracks in the three views. The data abstract tape may be rapidly scanned by a computer program; this program, without manual assistance or further reference to the film, yields an output tape containing selected events edited into a format suitable for processing by a standard geometry program. DAPR has been operated on five rolls of film from a 6 Gev/c proton exposure in the LRL 72″ HBC. This relatively difficult practice experiment was chosen as being the worst typical case which DAPR might soon face in actual physics experiments. A few representative frames are discussed in detail, and an analysis of the results of the entirely automatic DAPR scan for 4-prong events is given. These results are compared with the manual scan which was made as part of the HAZE processing of that experiment. The comparison of DAPR and manual scanning is very encouraging. While certain additions are needed to the degree of sophistication in parts of the system's logic, these are few in number and clear in concept. Even now the throughput of events is higher than was that of HAZE when physics production began. No mass of indistinguishable fake events contaminate the data. We believe therefore that DAPR stands at the threshold of doing actual physics experiments. (auth)

33507 (ANL–7515, pp 310–16) EXPERIENCE AT CERN OF THE AUTOMATIC MEASUREMENT OF SPARK CHAMBER PICTURES. Andersson, T. F.; Bowen, R. A.; Davies, H. E.; Lauper, S.; Metcalf, M. B.; Wilson, J. D. (European Organization for Nuclear Research, Geneva (Switzerland)).

The present status of spark chamber film measurement techniques is reviewed and new techniques which are likely to be the most important in the next few years are discussed. (B.G.D.)

33508 (ANL–7515, pp 317–27) PATTERN RECOGNITION FOR WIRE CHAMBER EXPERIMENTS. Evans, S. J. W.; Grote, H.; Metcalf, M. B.; Wilson, J. D.; Zanella, P. (European Organization for Nuclear Research, Geneva (Switzerland)).

The programming methods used at CERN for the pattern recognition of events recorded by wire spark chambers are outlined. The methods of event reconstruction from spark coordinates have been used, as far as possible, on the techniques used with visual spark chambers, but it has been necessary to devise new techniques in several cases. The description of these new methods and the reasons for using them are examined. (B.G.D.)

33509 (ANL–7515, pp 328–43) DEVELOPMENTS IN THE EVALUATION OF MAGNETIC FIELD SPARK CHAMBER PICTURES. Lassalle, J.-C.; Zanella, P. (European Organization for Nuclear Research, Geneva (Switzerland)).

Two new developments associated with pattern recognition and data handling in the operation of an optical spark chamber in a magnetic field are discussed. The first is the use of a CRT display and light pen to speed up the inspection and recovery of events which have not been recognized by the normal pattern recognition programs. The second is the approval of the Omega project for the construction at CERN of a large-aperture spectrometer magnet. A system of spark chambers will be operated inside the magnet and the project includes a dedicated data handling system capable of processing both the film and wire chamber information that will be produced. (B.G.D.)

33510 (ANL–7515, pp 344–52) USE OF CERN HPD 2 IONIZATION MEASUREMENTS. Atherton, H.; Blair, W.; Clayton, J.; (and others) (European Organization for Nuclear Research, Geneva (Switzerland)).

In an experiment at CERN, 90,000 $\bar{p}p$ interactions at 3.6 GeV/c in the 2 metre bubble chamber are being measured with HPD 2. The first part of the experiment involves the study of 20,000 $\bar{p}p$ 6-prong interactions; these events are now being processed and the HPD bubble density information is used in order to resolve the ambiguities left after the kinematical analysis. The main problem is to distinguish between those reactions having kinemati-

cally acceptable fits to two or more hypotheses involving the following sets of charged particles: $\bar{p}p \rightarrow 3\pi^+ 3\pi^-$, $k^+ 2\pi^+ 3\pi^-$, $3\pi^+ K^- 2\pi^-$, $K^+ 2\pi^+ K^- 2\pi^-$. The techniques adopted to do an ionization fit for each kinematic hypothesis and to choose the one which best fits the data are described. (auth)

33511 (ANL–7515, pp 353–61) IONIZATION MEASUREMENTS OF BUBBLE CHAMBER TRACKS WITH THE TELEVISION MEASURING PROJECTOR. Yekutieli, G.; Yaffe, R.; Toaff, S. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics).

Results on ionization measurements of bubble chamber tracks, with the Television Measuring Projector are reported. The ionization is measured up to 4 × minimum with relative error of less than 20%. Protons and pions can be identified and separated up to 1.5 GeV/c. The ionization measurements are used, with the help of the ionization χ^2 test, to choose the correct hypothesis of bubble chamber events, with 93% success. (auth)

33512 (ANL–7515, pp 382–9) PEPR'S IONIZATION MEASUREMENT. Watts, Terence L. (Massachusetts Inst. of Tech., Cambridge).

PEPR measures the ionization of a bubble chamber track by sweeping across it with a spot about equal in size to a bubble. A minimum ionizing track is adjusted to have 40% lacunarity (fraction of empty sweeps) and other tracks in an event are swept under the same conditions and compared in lacunarity. The ratio of logarithms of lacunarities is taken as a measure of ratio of β^2 of the tracks; a graph of this ionization measure vs momentum for pions and protons in 4C events in π^+p collisions at 3.9 GeV/c shows a separation up to 1 GeV/c. An ionization sum of squares was constructed, minimized, and tested for each hypothesis for an event; in 99 events, this test on the ionization sum of squares was compared to the decision on ionization made by a physicist at the scan table. In no events did the test assign an event uniquely to the wrong hypothesis. In 4000 events, 10% could not be assigned uniquely to a hypothesis by PEPR ionization, but could be assigned by a physicist at the scan table. A contribution to the fluctuation in ionization measurement was found to be caused by the sensitivity of PEPR to the position of the track with respect to the camera. The status of PEPR is as follows: the basic program (ELSCN) connecting scanning programs with hardware was reorganized; this speeded measuring by a factor of 10–15. The instantaneous rate of measuring was 120 events/hr and the best daily rate was 900 events/16 hr. A new experiment of 200,000 events is being tackled with minor changes in PEPR's operation but with the correlation of tracks from view to view done by program MATCH. (auth)

33513 (ANL–7515, pp 390–4) IONIZATION MEASUREMENTS ON POLLY. Loken, J. (Argonne National Lab., Ill.).

A preliminary report on ionization measurements of particle tracks in bubble chambers with POLLY is presented. A brief description of the POLLY system is included. Results of ionization measurements for the interaction $\bar{p} + \bar{p} \rightarrow k^+ + k^- + \pi^+ + \pi^-$ at 1.5 GeV are included. (B.G.D.)

33514 (ANL–7515, pp 395) IONIZATION INFORMATION FROM THE SPIRAL READER. Lynch, G. (California Univ., Berkeley. Dept. of Physics).

The ionization data obtained from the Spiral Reader is described and the way the data differs from all other systems is discussed. (B.G.D.)

33515 (ANL–7515, pp 396–7) COMPARISON OF BUBBLE CHAMBER IONIZATION MEASUREMENTS. Lynch, G. (California Univ., Berkeley. Dept. of Physics).

A comparison is made of seven methods of bubble chamber ionization measurement including HPD, TMP, FSD at BNL, FSD at LRL, PEPR, POLLY, and Spiral Reader. Three figures of merit were used for the comparison. The first was the constant k in the relation $\Delta I = k/\sqrt{L}$ where L is the length of the track in centimeters and ΔI is a standard deviation in the ionization (I) for a minimum ionizing track. The second quantity is ΔI for a track that is 40 cm long. The third quantity (I_{90}) is the 90 per cent confidence level for distinguishing from minimum ionization. (B.G.D.)

33516 (ANL–7515, pp 401–11) MINIMUM GUIDANCE PROGRAM AT THE UNIVERSITY OF PENNSYLVANIA. Bogart, E.; Adler, J.; Drum, C.; (and others) (Pennsylvania Univ., Philadelphia. Dept. of Physics).

The minimum guidance system at the University of Pennsylvania for processing bubble chamber film digitized on a HPD is described. The system is shown to operate in three phases: track-following, track-editing, and pattern recognition. New programs being developed for HPD analysis are also briefly discussed. (B.G.D.)

33517 (ANL–7515, pp 412–20) PATTERN RECOGNITION OF FOUR PRONG EVENTS. O'Donnell, R.; Bogart, E.; Hagopian, S.; Hagopian, V.; Ko, W.; Marshall, R.; Selove, W. (Pennsylvania Univ., Philadelphia. Dept. of Physics).

The purpose of Phase III of the minimum guidance system of the University of Pennsylvania for processional bubble chamber film digitized on a HPD is shown to be pattern recognition in four prong events. The performance of the HPD and all associated software was tested by first checking the accuracy and efficiency in measuring a sample of 127 events which were previously conventionally measured and processed through THRESH-GRIND. (B.G.D.)

33518 (ANL–7515, pp 421–30) THE STATUS OF CERN–RHEL MINIMUM GUIDANCE. Altaber, J.; Ferran, P. M.; Ganguli, S. N.; Gerard, J. M.; Head, A. E.; Krischer, W.; Nardi, J.; Sambles, A.; Williams, D. O. (European Organization for Nuclear Research, Geneva (Switzerland)).

A short account of the present status of the CERN HPD Minimum Guidance chain of programs in existence at the present time is presented. Minimum Guidance means the automatic measurement of bubble chamber events given a reasonably accurate premeasurement of event vertices and possibly some help with short or difficult tracks. It is intended to make a clear distinction between what has been done, what is being done and what is planned. In general, concentration is made on what has been done. (auth)

33519 (ANL–7515, pp 431–43) THE CERN TRACK-MATCH PROGRAM FOR VERTEX GUIDANCE BUBBLE CHAMBER MEASUREMENT SYSTEMS. Gerard, J. M.; Krischer, W.; Williams, D. O. (European Organization for Nuclear Research, Geneva (Switzerland)).

A status report on the CERN track match program for vertex guidance bubble chamber measurement systems is presented. Topics include identification of tracks, choice of tracks, and performance. (B.G.D.)

33520 (ANL–7515, pp 454–61) TANGENT GLOBAL METHOD OF PATTERN RECOGNITION AND MEASUREMENT. 2. BUBBLE CHAMBER EVENT PARAMETERS CALCULATED FROM TRACK TANGENTS. Sekely, M. E. (Princeton Univ., N. J. Palmer Physical Lab.).

A discussion on the calculation of bubble chamber event parameters from track tangents is presented. Topics include accuracies of track curvatures computed by the Sagitta (3 point) and by the Two Tangents method, extrapolating angles and curvatures to the vertex, corrections for optical distortions in the picture taking system and CRT distortions in the original PEPR, angles and curvatures in space, and momentum calculations. (B.G.D.)

33521 (ANL–7515, pp 444–53) TANGENT GLOBAL METHOD OF PATTERN RECOGNITION AND MEASUREMENT. 1. BUBBLE CHAMBER EVENT PATTERN RECOGNITION WITH LINE ELEMENTS. Sekely, M. E. (Princeton Univ., N. J. Palmer Physical Lab.).

The procedure for pattern recognition of bubble chamber tracks with line elements is outlined. The pattern recognition is accomplished by the following steps: recognition of points, recognition of line elements, recognition of tracks, and bubble counting. An appendix is included which examines errors of the point global methods. (B.G.D.)

33522 (ANL–7515, pp 462–7) TANGENT GLOBAL METHOD OF PATTERN RECOGNITION AND MEASUREMENT. 3. SPATIAL RECONSTRUCTION OF BUBBLE CHAMBER TRACK PARAMETERS WITH DIFFERENTIAL GEOMETRY. Sekely, M. E. (Princeton Univ., N. J. Palmer Physical Lab.).

A discussion on the spatial reconstruction of bubble chamber track parameters with differential geometry is presented. Topics include spatial reconstruction of angles and curvatures by differential geometry, transformation of track angles, transformation of track element differentials, equations of the helical track, track curvatures in space, errors of the track parameters, and errors in momentum. (B.G.D.)

33523 (ANL–7515, pp 477–80) FILM MEASURING SYSTEM AT JINR, DUBNA. Shigaev, V. (Joint Inst. for Nuclear Research, Dubna (USSR)).

The film measuring system at JINR, Dubna is briefly discussed. The film data reduction and physics analysis have been accomplished by two BESM-4 computers, a Minsk-22 computer and a CDC 1604A computer. In the future a BESM-6 computer will perform the same tasks. The scanning tables are briefly described with a brief note on on-line systems. Some details of the CRT automatic measuring device for spark chamber films are included. (B.G.D.)

33524 (JINR–P11-4463) MATHEMATICAL SIMULATION OF TRACKS BY SPIRAL SCANNING. Ososkov, G. A. (Joint

Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1969. 16p. (In Russian). Dep.

The equations and the probability algorithms for simulation of the numerical information received from the flying-spot digitizer with spiral scanning are presented. Tracks of events and the tracks of noninteracted beam particles are represented as circle segments; noise points are considered to fill the scanning field uniformly. (auth)

33525 ACOUSTIC SPARK CHAMBER FOR RECORDING MULTITRACK EVENTS. Vovchenko, V. G.; Ovchinnikov, B. M.; Fedorov, O. Ya. (Physical-Technical Inst., Leningrad). Prib. Tekh. Eksp., No. 2, 40-5(Mar.-Apr. 1969). (In Russian).

An acoustic spark chamber for recording multitrack events is described. The chamber used electrostatic-type microphones with automatic supply of displacement. Each microphone with amplifier permits recording of separate sparks at distances up to 4mm from the microphones. The utilization of four microphones in discrete intervals in the spark chamber permits recording of separate sparks at distances up to 2mm from each other. (tr-auth)

33526 THE 300-LITER BUBBLE CHAMBER PK-300. Alikhanyan, A. I.; Aleksanyan, A. S.; Arutyunyan, N. Kh.; Bekker, B. I.; Veremeev, M. M.; Kankanyan, S. A.; Kavalov, R. L.; Levonyan, E. Ts.; Pikhtelev, R. N. (Inst. of Physics, Erevan). Prib. Tekh. Eksp., No. 2, 45-8(Mar.-Apr. 1969). (In Russian).

A bubble chamber with a sensitive volume of 300 liters and dimensions $100 \times 50 \times 60$ cm^3 for operation with bundles of particles from a 6-GeV synchrotron is described. The chamber can be filled with liquids, the working temperature of which lies within the limits 20 to 70°C and is placed in a magnetic field with an intensity of approximately 17 kilogauss. (tr-auth)

33527 SPARK CHAMBER WITH ROTATED ELECTRIC FIELD. Kozlov, M. I.; Rudenko, N. S. (Tomsk Polytechnical Inst., USSR). Prib. Tekh. Eksp., No. 2, 48-51(Mar.-Apr. 1969). (In Russian).

A method is described for increasing the stereo isotropism of spark chambers with large interelectrode distances, recording in the form of sparks charge particle tracks in a solid angle of 3π. The method for creating the rotated pulsed electric field is described. The method for formation of sparks and the method for photography of these sparks are discussed. (tr-auth)

33528 MAN–MACHINE COOPERATION IN DIGITAL PATTERN RECOGNITION OF BUBBLE CHAMBER TRACKS. Strand, R. C. (Brookhaven National Lab., Upton, N. Y.). Ann. N. Y. Acad. Sci., 157: 65-82(Mar. 31, 1969).

From Conference on Data Extraction and Processing of Optical Images in the Medical and Biological Sciences, New York. See CONF-670635.

Manual extraction and computer processing of bubble chamber data, semi-automatic data extraction, design and implementation of the track recognition programs, and FSD system data extraction and processing operations are discussed. (W.H.K.)

33529 SOLID STATE SCINTILLATION DETECTOR FOR HIGH-ENERGY CHARGED PARTICLES. Bateman, J. E. (Glasgow Univ.). Nucl. Instrum. Methods, 71: 261-8(1969).

A completely solid state scintillation detector for high energy charged particles is described. The device consists of a scintillator, a photodiode to which the scintillator can be optically coupled, and a charge sensitive preamplifier, all mounted in a small tubular assembly. The viability of the device as a detector for use in nuclear and high energy physics is demonstrated, and its properties examined. Results are given with various scintillators stopping 48.8 MeV protons, the best energy resolution being 2% fwhm when CsI(Tl) is used. (auth)

33530 SOME RECENT RESULTS WITH A PHOTODIODE–ORGANIC SCINTILLATOR COMBINATION USED AS A DETECTOR FOR HIGH ENERGY CHARGED PARTICLES. Bateman, J. E. (Glasgow Univ.). Nucl. Instrum. Methods, 71: 269-72(1969).

The use of a new organic scintillator in conjunction with a silicon surface barrier photodiode as a detector for high energy charged particles is described. The best resolution obtained is 10.3% fwhm for 49.15 MeV protons. The scintillator decay time constant is shown to be ~15 ns. The potential for further development of the detector is examined. (auth)

33531 AUTOMATIC SCANNER BASED ON AN ELECTRON-BEAM TUBE. Borisovskii, V. F.; Dikusar, N. D.; Ermolaev, V. V.; Zlobin, A. D.; Kukhtina, I. N.; Skryl, I. I.; Filippov, A. I.; Shigaev, V. N.; Shkundenkov, V. N. (Joint Inst. of Nuclear Studies, Dubna, USSR). Dokl. Akad. Nauk SSSR, 185: 306-8 (1969). (In Russian).

The optical system of an automatic scanner for handling photos from spark chambers is presented. A television-type light raser is formed on the screen of an electron tube. Three optical channels are formed by means of an objective and two prisms having semitransparent surfaces: one for the photo, one for a dashed-line lattice, and one for a diagonal line. A photomultiplier on each channel measures the change in light flux. Reference pulses are formed by means of a dashed-line lattice having a step $\Delta x = 60$ microns. The period of the pulses is divided into K parts, where K is equal to 2 or 3 to determine a coordinate of 20 or 30 microns. The y coordinate is determined by the diagonal line. A computer is linked to the flying spot device, and is programmed to take readings on photos from spark chambers. The accuracy of reading the field coordinates was determined by scanning a test photo 12×20 mm^2. The error corridor in reproducing the test picture was 12 microns. These results satisfy the accuracy requirements of reading coordinates of spark chamber pictures. (TTT)

Radiation Dosimeters

Refer also to abstract 33483.

33532 (AE-362) THE APPLICATION OF THERMOLUMINESCENCE DOSIMETERS TO STUDIES OF RELEASED ACTIVITY DISTRIBUTIONS. Ruden, B-I. (Aktiebolaget Atomenergi, Stockholm (Sweden)). June 1969. 46p. Dep.

The theoretical conditions necessary are considered for the study of the behavior of released activity by the use of $CaSO_4$: Mn thermoluminescence dosimeters. A method is derived for calculating exposure distributions from drifting volume activity. The correlation between exposure distributions and concentration distributions is discussed. One of thirty experiments where bromine-82 was released into water through a nozzle some meters above the bottom is described. The resulting exposure distribution was measured in a vertical plane at distances of 10, 50 and 200 meters by $CaSO_4$: Mn thermoluminescence dosimeters. The measured exposures are described and discussed. The advantages and disadvantages of the technique are compared with other methods. The method using exposure measurements for the study of active release in water has given satisfactory results in practice. The measurements were made at concentration levels which are considerably below that permissible for drinking water according to the recommendations by I.C.R.P. A special advantage with this method is that the measurements can be made simultaneously at a large number of places and that integration is possible over sufficiently long periods of time. (auth)

33533 (CEA-tr-X-656) RADIOLUMINESCENCE DOSIMETRY. II. THERMOLUMINESCENCE METERS. Spurny, Z. Translated into French from Jad. Energ., 10: 246-51(1964). 20p. (In French). Dep.

The experience acquired in the fabrication of devices for the measurement of light emission as a function of the temperature of the material (thermoluminescence) was summarized and reported. The principal parts of the thermoluminescence meters including the detector, black box, heat installation, and power sources are described. (J.S.R.)

33534 (FOA-4-4389) INTERNAL LiF BETA-RAY DOSIMETRY. Greitz, U.; Ruden, B-I. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). June 1969. 6p. Dep.

Beta energy calibration of LiF–Teflon rod dosimeters was carried out. Solutions of ^{35}S, ^{99}Tc, ^{204}Tl, and ^{90}Y were used as radiation sources. The mean beta-energy covered the range 0.05 to 0.90 MeV. The dosimeters were exposed in a geometry corresponding to a self-shielding effect over the entire energy range studied, and the results are in good agreement with theoretical calculations reported recently. (auth)

33535 (HASL-206) FEASIBILITY STUDY OF USING LiF DETECTORS IN A NEUTRON FLUX INTEGRATOR. Lazanoff, Arthur S.; McLaughlin, James E. (New York Operations Office (AEC), N. Y. Health and Safety Lab.). Mar. 1969. 28p. Dep. CFSTI.

In place of the widely used ^{59}Co disks, thermoluminescent LiF detectors were exposed inside a flux moderator to known Pu-Be neutron fluences to determine the correlation between the detector light output and the exposure. LiF in the powdered form produced a thermoluminescent output that was linear with respect to an exposure range from 10^6 to 10^8 n/cm^2. Solid LiF squares were less sensitive than the powder, and their response was nonlinear. A theoretical neutron energy response function from Bonner sphere data was derived and it was found that the neutron response of the detector can vary as much as a factor of two when exposed to different neutron energy spectra. To infer accelerator or reactor stray radiation dose information, further experimental work is

planned on energy response and on neutron and gamma-ray discrimination. (auth)

33536 (NP-17843) THOUGHTS ON DESIRABLE PROPERTIES OF A DOSIMETER FOR PRIVATE PROTECTION ROOMS. Pretre, S. (Forschungsinstitut fuer Militaerische Bautechnik, Zurich (Switzerland)). Feb. 1969. 11p. (In German). Dep.

The characteristics which a dosimeter for private fall-out shelters should possess are outlined. Topics include purpose; users; type; handiness; weight and size; water, shock, and temperature resistance; power supply; calibration; maintenance; accuracy; measuring range; recorder system; lifetime; operation instructions; cost; and interpretation of data. (J.S.R.)

33537 (NP-tr-1767) CHEMICAL DOSIMETRY OF IONISING RADIATIONS WITH THE LEUCO COMPOUNDS OF SOME TRIPHENYL METHANE DYES IN POLYSTYRENE. Stolz, W.; Prokert, K. Translated by D. Verdin (Atomic Energy Research Establishment, Harwell, Eng.), from Kernenergie, 8: 425-9 (1965). 11p. Dep.

The possibility of using the leuco compounds of benzaurin, fuchsin, Doebner's violet, methyl violet, crystal violet, and malachite green in polystyrene for the chemical dosimetry of γ and β radiation has been examined. The dosimeters were in the form of thin films of polystyrene in which the leuco compound of one of these dyes and a halogenated hydrocarbon of low volatility were incorporated. During irradiation the corresponding triphenyl methane dyes were formed in the films in amounts which were proportional to the energy absorbed. The dose rate dependence, the temperature dependence, and the reproducibility of the dosimeter reactions were examined. The reaction mechanism is discussed. (auth)

33538 ANOMALOUS FADING OF CaF_2:Mn THERMOLUMINESCENT DOSIMETERS. Schulman, J. H.; Ginther, R. J.; Gorbics, S. G.; Nash, A. E.; West, E. J.; Attix, F. H. (Naval Research Lab., Washington, D. C.). Int. J. Appl. Radiat. Isotop., 20: 523-9(July 1969).

A surprising effect encountered in the application of the thermoluminescence of CaF_2: Mn to dosimetry is the initially high fading rate. This fading is much more rapid than would be expected considering the high-temperature, apparently uncomplicated glow curve of CaF_2: Mn. The effect is present when rapid heating rates (~1500°C/min) are used to obtain the glow curve, but when slow heating rates (~20°C/min) are employed no fading is observed. It was determined that the glow curve is a composite of several closely spaced components of varying stability. With rapid heating rates all the glow curve components are shifted upward in temperature, causing preferential thermal quenching of the stabler (higher temperature) components. The composite glow curve is thus distorted and the unstable components, being attenuated to a lesser degree, give a greater contribution to the thermoluminescence output. (auth) (UK)

33539 ANTHRACENE GELATINE FILMS FOR LUMINESCENCE DEGRADATION DOSIMETRY. Ilic-Popovic, J.; Hjortenberg, P. E. (Danish Atomic Energy Commission Research Establishment, Risoe). Int. J. Appl. Radiat. Isotop., 20: 541-8 (July 1969).

The luminescence degradation of anthracene was studied, and an attempt was made to develop a workable system for high-dose dosimetry. It was shown that an anthracene-gelatine film is suitable. The relationship between fluorescence and absorbed dose, for 10 MeV electrons and ^{60}Co γ-rays, was investigated. (auth) (UK)

33540 RADIOMETRY OF X-RAY AND GAMMA-RAY BY CHEMICAL DOSIMETRY: USE OF LENCO COMPOUNDS. Sakamaki, K. Kokobyogakkai Zasshi, 34: 485-7(Dec. 1967). (In Japanese).

The dosimetry of the mouth is difficult due to the irregular array of different tissues, bones, and voids within a small volume. Experiments were carried out to determine the usability of the leuco compound 4,4'-(5-chloro-2-thenylidene) bis N,N-dimethylaniline as a dosimeter for oral radiation treatments. The compound was used as a 10^{-4}M solution in a 10^{-4}M Mohr salt and NaCl solution, with its pH adjusted to 2.2. The originally colorless solution developed a color with an absorption peak at 635 mμ after irradiation. The dose-color intensity relation was found to be linear within the 200 to 2000 R range for dose rates of 33 to 78 R/min which cover the clinically used range. Dose rates exceeding 400 R/min result in an 8% loss in optical density. No difference was found between irradiations administered using 48.87 and 1250 keV beams. The volume dose reading agreed with the data obtained with a Murai plastic scintillator. It was concluded that the above compound may be used for dosimetric measurements in the oral cavity. Further clinical tests will be carried out later. (TTT)

33541 PHOSPHATE GLASS FOR X-RAY, GAMMA RAY, AND THERMAL NEUTRON DOSIMETERS. Carpentier, Serge; Delarue, Roger; Francois, Henri; Grand-Clement, Anne-Marie; Portal, Guy; Soudain, Georges (to Commissariat a l'Energie Atomique). U. S. Patent 3,449,136. June 10, 1969. Priority date Mar. 5, 1965, France.

Glass for x-ray, γ-ray, and thermal neutron dosimeters having a base of oxygenated compounds of phosphorus including silver as activator, consisting essentially of the percentage composition by weight of metal oxide and of phosphorus pentoxide is comprised between the following limits: Li_2O → (0-1.5%), BeO → (5-15%), Na_2O → (0.1-10%), Al_2O_3 → (0.1-10%), Ag_2O → (1.5-10%), and P_2O_5 → (71.8-80.6). (Official Gazette)

33542 DOSIMETER FOR HIGH LEVELS OF ABSORBED RADIATION. Pezdirtz, George F.; Bell, Vernon L. Jr. (to Administrator of the National Aeronautics and Space Administration). U. S. Patent 3,450,878. June 17, 1969. Filed Dec. 8, 1966.

A dosimeter for measuring unknown radiation dosage in the range of 1-1000 megarads of absorbed radiation in which the intrinsic viscosity measurement is taken of a solution of the unknown with the unknown radiation dosage being read from a standard radiation curve plotted from known dosage/intrinsic viscosity measurements. (Official Gazette)

33543 CONTROLLED DEFECT COLORATION DOSIMETER. Muller, Albert C. (to United States Atomic Energy Commission). U. S. Patent 3,453,430. July 1, 1969.

This patent relates to a coloration radiation dosimeter in which the color centers in the crystal structure consist of lattice defects, rather than impurities, sensitive to ionizing radiation. (auth)

33544 MEASURING INSTRUMENT FOR USE WITH A THERMOLUMINESCENT DOSIMETER. Schayes, Raymond; Gourlet, Roger (to Manufacture Belge de Lampes et de Materiel Electronique en abrege MBLE). U. S. Patent 3,450,884. June 17, 1969. Priority date Oct. 1, 1965, Belgium.

A radiation detection system for a thermoluminescent dosimeter includes a photodiode, a resistor and a capacitor in series across a voltage source. A dc amplifier has its input terminals connected across the series combination of the resistor and capacitor. A diode is connected between the amplifier output and one electrode of the capacitor and is poled so as to charge the capacitor to a voltage that is equal and opposite to the maximum voltage developed across the resistor. (Official Gazette)

33545 DOSE EQUIVALENT RADIATION SYSTEM. Baum, J. W. (to United States Atomic Energy Commission). U. S. Patent 3,457,413. July 22, 1969.

This patent relates to a dose equivalent radiation meter for detecting and measuring mixed radiation fields having an amplifier for converting counter pulses into a pulse spectrum weighted for quality factor to represent roentgen equivalent man (REM) measurements of said radiation. (AEC)

33546 ADDITIONAL BIBLIOGRAPHY OF THERMOLUMINESCENT DOSIMETRY. Spurny, Z. (Nuclear Research Inst., Prague). Health Phys., 17: 349-54(Aug. 1969).

A bibliography of 172 references is presented. In conjunction with the latest list of Lin and Cameron (Health Phys., 14: 495 (1968)), this will create perhaps the most complete list of references up to the 2nd International Conference on Luminescence Dosimetry in Gatlinburg, September 1968. (auth) (UK)

Radiometric Instruments

33547 DEVICE FOR READING CARDS WITH RADIATION. Tateishi, Kazuma (to Tateisi Electronics Co.). Japanese Patent 1968-28370. Dec. 6, 1968. Filed July 19, 1966.

A card-reading device is proposed which uses radiation, but no radioactive substance is embedded in the card. The advantages are low cost of the cards and elimination of the harmful radiation. A radiation scattering or absorbing substance is appropriately distributed in the card. A device to irradiate the card in the form of a sheet, where each part differs in the amount of contained radioactive material, is located on one side of the card; and the radiation detector is located on the other side of the card. (NSA of Japan)

33548 METHOD AND APPARATUS FOR SELECTING GAS PRESSURES OVER A WIDE RANGE. Boiziau, Claude (to Commissariat a l'Energie Atomique). U. S. Patent 3,449,659. June 10, 1969. Priority date Aug. 3, 1964, France.

A radioactive source pressure gauge and a method of measuring gas pressure over a wide range are described. An ionization chamber comprised of a stainless steel cylinder communicating with a gas enclosure under study houses a radioactive source, which may be selectively energized with a dc voltage, and a helical grid spaced from the source to define a path for ionized gas. A metal probe mounted within the volume defined by the helical grid is electrically connected to the radioactive source where it will influence the electric field within the ionization chamber and restrict the mean free path of the ions in order to prevent recombination. An amplifier and display meter are connected to the grid to monitor the ionization current. By selectively de-energizing the source and probe the meter may be calibrated to display only ionization current. (auth)

33549 LA RADIOGRAPHIE ECLAIR. (Luminescence Radiography). Beaudouin, L. Saclay, France, Institut National des Sciences et Techniques Nucleaires. Paris, Presses Universitaires de France, 1968. 220p.

Emission ensembles are discussed covering high voltage feeding, energy reservoirs, shock generators, electric performance of shock generators, sources of luminescence radiography, and electric characteristics of ensemble emission. Also electrons, x rays, doses, parameter effects on x-ray emission, electron spectra, and x rays, lifetime of electron sources and of x rays, and a comparison between emission ensembles are considered. Receiving ensembles are also discussed including antiscattering grids, optical guides, and metallic screens, mineral scintillators, radiographic films, association of films and mineral scintillators, stereoradiography, cineradiography, application to luminescence radiography, and related techniques. (J.F.P.)

Miscellaneous Instruments and Components

Refer also to abstracts 33146, 33231, 33297, 33940, 33968, 34564, 34734, 34802, and 34908.

33550 (CEA-CONF-1234) ANALOG MEMORY DEVICE FOR MULTIPARAMETER ANALYSIS. Cortella, J.; Musart, R.; Potin, J. (Commissariat a l'Energie Atomique, [Paris] (France)). 1968. 11p. (In French). (CONF-680955-2). Dep.

From International Conference on Nuclear Electronics, Versailles, France.

During multiparametric experiences with an on-line computer, several pulse amplitudes arrive to be coded simultaneously. The use of temporary analog memories to store the amplitudes allows a single digital-to-analog converter to do the codings successively. The analog memory element is a capacitor charged by the peak voltage of the pulse to be coded. The recording and reset to zero functions of the memory are assured by field-effect transistors used in switching. The readout of the memory is permanent and nondestructive, and a linear gate calibrates the output voltage. After a storage time of 5×10^{-4} sec (time necessary to code and process arithmetically the data) the total measurement error (linearity and voltage loss) is less than 10^{-2}. (tr-auth)

33551 (CEA-R-3768) NOTE CONCERNING THE ECASAC PROGRAMME. Bras, Daniel (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar. 1969. 23p. (In French). Dep.

The analytical program for ECAP electronic circuits, operated initially on the IBM 1620 computer with limitations on the size of the program but equipped with a typewriter. The IBM 360 computers made it possible to increase the size of the programs, but the ECAP 360 did not utilize a typewriter. The ECAP was adapted to the EAI 8400 computer. Without diminishing it in any way, EAI 8400 was modified to provide it with conversational characteristics by using the computers control panel. To obtain further flexibility it was made to record curves during the calculation operation and to obtain a division of the printed results. To obtain the curves, use was made of analog digital converters of the interface of the hybrid unit EAI 8900 of which the EAI 8400 computer represents the numerical section. The modifications concerned the A.C. analysis and the transient analysis, facilitated and completed the input of the data, allowed modifications to be made for the calculation of these analyses, improved the presentation of the results, and facilitated interpretations. ECASAC constitutes ECAP 360 made conversational by use of a typewriter with automatic out put of the curves. (auth)

33552 (JINR-P7-4469) PRODUCTION OF HIGHLY STRIPPED IONS IN ULTRAHIGH-VACUUM ELECTRON-BEAM SOURCE. Donets, E. D.; Ilyushchenko, V. I.; Alpert, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1969. 16p. (In Russian). Dep.

C^{+5}, N^{+6}, and O^{+7} ions were observed at the output of the electron-beam ion source by working with the residual gas atoms. Detection of bare nuclei of C, N and O was made difficult due to the presence of intense H_2^+ line. In preliminary experiments on gold ionization the ions up to Au^{+19} were obtained. The experimental value of the ionization cross section $N^{+5} \rightarrow N^{+6}$, which turned out to be anomously large, is discussed. (auth)

33553 (KFKI-11/1969) LOCK-IN AMPLIFIER FOR NMR SIGNAL DETECTION. Toth, F.; Tompa, K. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Apr. 15, 1969. 11p. Dep.

A lock-in amplifier with 100 kohm and 100 ohm input impedances, built for the detection of signals in the presence of high background noise, is described. The minimum detectable signal is of order 1 nV for 10^{-20} W, generating 100 ohm input impedance with an observation time of less than 1 min. The operating frequency can be varied per stage. The phase angle of the signal relative to the reference can be changed from a linear angular scale to better than ±2% accuracy. (auth)

33554 (WANL-TME-841) DESIGN OF A FEEDBACK-SHIFT-REGISTER PSEUDO-RANDOM SIGNAL GENERATOR FOR IMPULSE RESPONSE MEASUREMENTS. Honka, E. K. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). June 18, 1964. 20p. Dep. CFSTI.

The Pseudo-Random Pulse Generator described is basically a string or cascade connection of electrical storage elements (flip-flops) operating as a shift register. Binary bits of information, called +1 or −1, are stored in each storage stage and the content of each of these storage units is moved one step forward into the next storage unit every time the shift register is pulsed by a so-called clock pulse provided from an external pulse generator. Before this shifting, a multiplier calculates the product of the contents of two or four of the shift-register storage elements (specially selected); stores this product temporarily; and, during the shifting operation, transfers this product into the first shift-register stage. As a result of this method of generation, the successive inputs to the sequence of states at any stage of the shift-register generator is cyclic, but the length of the repeated sequence is longer than the number of the shift-register stages. (W.H.K.)

33555 AMPLITUDE DISCRIMINATOR WITH RESOLVING TIME OF 5.5 NANOSECONDS. Tsaregorodtsev, M. N.; Borzunov, G. I. (Moscow Engineering-Physics Inst.). Prib. Tekh. Eksp., No. 2, 87-90(Mar.-Apr. 1969). (In Russian).

A nanosecond amplitude discriminator is described. A dynamic analysis in the region of the tunnel-diode univibrator with a nonlinear load is presented. The amplitude discriminator which was constructed on the basis of the univibrator has a resolving time of 5.5 nanoseconds. (tr-auth)

33556 AN AMPLIFIER APPARATUS FOR OPERATION WITH A SUPERCONDUCTING BOLOMETER. Khebtov, I. A. Prib. Tekh. Eksp., No. 2, 94-7(Mar.-Apr. 1969). (In Russian).

An input apparatus for operation with a superconducting bolometer which consists of a resistance bridge, a cooled transformer, and a low-noise preamplifier is described. The level of noise in the apparatus which is present at the input of the transformer is given. The resistance to the signal source is 1.0 ohm at a temperature of 3.7°K. (tr-auth)

33557 GENERATOR OF A SERIES OF PULSES WITH EXPONENTIALLY INCREASING FREQUENCY. Kazachkov, V. I.; Aref'eva, I. V. (Scientific Research Inst. of Complex Automation, Moscow). Prib. Tekh. Eksp., No. 2, 99-101(Mar.-Apr. 1969). (In Russian).

A generator is described which permits production of a series of pulses with exponentially increasing frequency in the range 100 to 1000 pulses/sec in constant time intervals from 10 to 100 seconds. The amplitude of the pulses can be regulated from 1 up to 100 mV, the duration of the front of the pulse 0.3 μsec, and the duration ~2 μsec. The apparatus can also generate exponentially increasing voltages of 3 to 100 V in the same constant time intervals. (tr-auth)

33558 A GENERATOR OF NANOSECOND RECTANGULAR PULSES WITH AMPLITUDES OF 500 kV. Mesyats, G. A.; Khmyrov, V. V.; Isipov, V. P. (Tomsk Polytechnical Inst., USSR). Prib. Tekh. Eksp., No. 2, 102-4(Mar.-Apr. 1969). (In Russian).

A generator of pulses with amplitudes of 50 to 500 kV, duration of 10 to 40 nanoseconds, and frequency of 1 to 50 Hz is de-

scribed. The duration of the front of the pulse is 3 nanoseconds. (tr-auth)

33559 MEASUREMENT OF WEAK BEAMS OF CHARGED PARTICLES WITH ELECTRON MULTIPLIERS AND ELECTROMETRIC AMPLIFIERS. Mamyrin, B. A.; Paleev, V. I. Prib. Tekh. Eksp., No. 2, 169-70(Mar.-Apr. 1969). (In Russian).

An apparatus is proposed which consists of an electron multiplier and an electrometer for recording weak beams of negatively or positively charged particles. (tr-auth)

33560 PHOTOMULTIPLIERS WITH LOW NOISE LEVEL. Golkovskii, G. M.; Kovaleva, T. A.; Kuptsova, G. Z.; Melamid, A. E. Prib. Tekh. Eksp., No. 2, 171-2(Mar.-Apr. 1969). (In Russian).

The design parameters of FEU-42M and FEU-43M photomultipliers for recording of weak light beams are presented. The photomultipliers have alloy dynodes and a front semitransparent antimony–cesium photocathode ϕ38 and 75mm. The counting characteristics and the amplitude distribution of pulses of dark current are discussed. (tr-auth)

33561 MEASUREMENT WITH HIGH-SPEED COUNTER WITH AUTOMATIC RECORDING. Karabanov, N. I.; Loksh, A. I. (All-Union Scientific-Research Geological Inst., Leningrad). Prib. Tekh. Eksp., No. 2, 74-6(Mar.-Apr. 1969). (In Russian).

The electronic circuit of a transistorized high-speed counter with automatic recording is presented. The changes in readings in the temperature range +20 to +50°C and +20 to –10°C does not exceed ±3 to 5%. (tr-auth)

33562 A SYSTEM FOR AUTOMATIC REGULATION OF PHOTOMULTIPLIER AMPLIFICATION. Antoshchenko, E. M. (Scientific Research and Experimental Construction Inst. of Ferrous Metallurgy, Dnepropetrovsk, USSR). Prib. Tekh. Eksp., No. 2, 86-7(Mar.-Apr. 1969). (In Russian).

A method is proposed for automatic regulation of photomultiplier amplification, utilizing several of the later cascades and permitting a significant decrease in the limits of change in the regulation of voltage in comparison with known methods. (tr-auth)

33563 THE STABILIZATION OF TOTAL BALANCE OF DOUBLE-T BRIDGES USED IN NMR SPECTROMETERS. Kucheryaev, A. G.; Ovchinnikov, I. M.; Oliferchuk, N. L. (Physical-Technical Inst., Sukhumi, USSR). Prib. Tekh. Eksp., No. 2, 124-7(Mar.-Apr. 1969). (In Russian).

Plans are described for stabilization of the total balance of rf bridge and hf phase detector being used for the detection of NMR signals. Results of investigation with these plans are reported. (tr-auth)

33564 METHOD FOR FOCUSING CORRECTION OF MAGNETIC ION-OPTICAL SYSTEMS WITH THIN CONTOURED SHIMS. Malov, A. F.; Suzdalev, V. A.; Fedoseev, E. P. (Inst. of Atomic Energy, Moscow). Prib. Tekh. Eksp., No. 2, 146-51(Mar.-Apr. 1969). (In Russian).

A method for focusing correction of ion-optical systems used in electromagnetic mass separators, mass spectrometers, and nuclear spectrometers is described. The method is based on the local variation of the focusing magnetic field with pairs of thin contoured shims being placed in the interpolar space of the focusing magnet. The general character of spatial focusing is kept unchanged. The method was examined on electromagnetic mass separators for the separation of isotopes of heavy elements, where excellent results were obtained. (tr-auth)

33565 X-RAY INTERFEROMETER USING THREE SPACED PARALLEL CRYSTALS. Bonse, Ulrich Karl; Hart, Michael (to Research Corp.). U. S. Patent 3,446,961. May 27, 1969. Filed Feb. 1, 1966.

An x-ray interferometer is described in which a single crystal is used as the x-ray element. Three upstanding and parallel walls which are joined to a base act as a beam splitter, transmission mirrors, and analyzer. (Offic. Gaz.)

33566 THE JODRELL BANK RADIO FREQUENCY DIGITAL AUTOCORRELATION SPECTROMETER. Davies, R. D.; Ponsonby, J. E. B.; Pointon, L.; De Jager, G. (Nuffield Radio Astronomy Labs., Jodrell Bank, Eng.). Nature(London), 222: 933-7 (June 7, 1969).

A versatile digital autocorrelation spectrometer, designed and built at Jodrell Bank, is described, together with some examples of observations made with the new instrument. (auth) (UK)

33567 GAS SAMPLING OF FUEL ELEMENTS BY LASER PIERCING TECHNIQUES. Lilley, W. (Atomic Energy Research Establishment, Harwell, Eng.). Atom, No. 152, 166-76(June 1969).

Gas sampling plays a very important part in post-irradiation studies of reactor fuel elements, and a new gas sampling facility, designed at Harwell, using laser piercing techniques is described. The work involved in producing a practical laser piercing system from information obtained during feasibility experiments is described, including commissioning trials and operating experience. Safety is also discussed. The facility is particularly suited to batch work. A ruby laser is employed. (UK)

33568 DETERMINATION OF PARTICLE CONCENTRATION BY EXTINCTION OF CHERENKOV RADIATION. Ashcroft, J. (Microbiological Research Establishment, Porton, Eng.). Int. J. Appl. Radiat. Isotop., 20: 555-7(July 1969).

With the development of liquid scintillation counters the routine observation of Cherenkov radiation has become possible. Cherenkov radiation is emitted when a charged particle passes through a medium with a velocity greater than the velocity of light in that medium. The Cherenkov spectrum is continuous, and is concentrated mainly in the ultraviolet, but it does extend into the visible. This note describes attempts to use Cherenkov radiation as a light source in the determination of particle concentrations by light extinction. (auth) (UK)

33569 MASS SPECTROMETER WITHOUT MEMORY EFFECT FOR GAS ANALYSIS IN ULTRAHIGH VACUUM. Gentsch, H. (Technical Univ., Hanover). J. Vac. Sci. Technol., 6: 93-6 (Jan.-Feb. 1969).

From 15th National Vacuum Symposium, Pittsburgh, Pa. See CONF-681012.

The described Omegatron mass-spectrometer is equipped with an internal heating device. All inner metal parts of the Omegatron gauge are made of noble metal and can be held during the measurements at a maximum temperature of ≈500°C. For cleaning and degassing the gauge the temperature of the metal parts can be increased up to 900°C. All parts of the gauge made of base metals are enameled. The fact that the memory effect can be held down by the entirely heatable Omegatron is a new and important criterion for measurements of partial pressures in the ultrahigh vacuum range. A further advantage of the heatable Omegatron-box is the remarkable constancy of ion transmission which is obtained at constant electrode-potentials even after many heating-cycles. (auth)

33570 SOME PROPERTIES OF THE MONOPOLE MASS SPECTROMETER. Dawson, P. H.; Whetten, N. R. (General Electric Research and Development Center, Schenectady, N. Y.). J. Vac. Sci. Technol., 6: 97-9(Jan.-Feb. 1969).

From 15th National Vacuum Symposium, Pittsburgh, Pa. See CONF-681012.

Monopole mass spectrometer characteristics have been analyzed by determining ion trajectories under various operating conditions. The trajectories were obtained by numerical integration of the equations of motion. Peak shapes were derived for ions spending 20 rf cycles in the field, for various entrance/exit slit ratios, with ion injection parallel to the instrument axis. Comparison with earlier results shows that resolutions at half-height can be expressed as $(n/p)^2$, where n is the number of cycles an ion spends within the field and p is constant for a given exit slit-width. Ion injection at an angle to the instrument axis was also considered. Peaks then showed much less spread on the low mass side. For ions entering the field at a fixed angle, the peaks may exhibit a central dip if the exit slitwidth is too small. (auth)

33571 IMPROVEMENTS IN OR RELATING TO PULSE ANALYSING AND COUNTING ARRANGEMENTS. Kandiah, Kathirkamathamby (to United Kingdom Atomic Energy Authority). British Patent 1,153,574. May 29, 1969. Filed Aug. 13, 1965.

Difficulties with conventional pulse analyzing and counting systems are briefly summarized. In the improved system described an input capacitor (detector) is provided, across which electrical signal pulses are developed due to the incidence of radiation, together with means for supplying to this capacitor a discharging current which compensates for the mean charging current due to the signal pulses, this means comprising a light-responsive semiconductor device, and adjacent to this device a light emitting semiconductor device which emits light of controllable intensity when electrically energized. The light-responsive device is arranged to feed to the input capacitor a discharging current of duration and magnitude controlled by the signal to the light emitting device. The light responsive device may comprise a photodiode, and the light emitting device may comprise a light diode, and flashes of light from the latter reduces the impedance of the photo-diode depending on the intensity of the flash. Various controlled filtering arrangements may be employed. (UK)

33572 EFFECT OF IRON SHIELD ATTACHED TO ELECTROMAGNET DESIGNED FOR NUCLEAR G-FACTOR MEASUREMENTS. Tomiyama, Tsuyoshi; Aoki, Atsushi (Kyoto Prefecture Univ.). Sci. Rep. Kyoto Pref. Univ. (Nat. Sci., Living Sci., Welfare Sci.), No. 19, 9-10(Oct. 1968). (In Japanese).

The effect of an iron shield, about 3 mm thick, which was attached outside the coils of an electromagnet for nuclear g-factor measurements by the angular correlation technique was studied. With 22 kg as the magnetic-field strength of the gap between the magnetic poles, the intensity of leakage field 200 cm away from the center of the poles was 2 G, about $^1/_{10}$ of the value without the shield. If a permalloy shield was provided in the multiplier phototube with a 3″ × 3″ NaI(Tl) the practical shielding effect could be observed. (NSA of Japan)

33573 DEPOSITION OF UNATTACHED RADON DECAY PRODUCTS IN AN IMPACTOR STAGE. Mercer, T. T. (Univ. of Rochester, N. Y.); Stowe, William A. Health Phys., 17: 259-64(Aug. 1969).

Depending on impactor design and flow rate, as much as 80% of available unattached RaA and ThB atoms can be collected in a round-jet impaction stage in a convenient form for analysis. The collection efficiency decreases linearly, but slowly, with increasing flow rate. This is shown to be due to a diffusional process not significantly affected by either relative or absolute humidity. (auth) (UK)

33574 PROCESS REGULATION AND INSTRUMENTATION AT INSTITUTT FOR ATOMENERGI. Christensen, Helge (Institutt for Atomenergi, Kjeller, Norway). Tek. Ukebl., 116: 454-7(Apr. 17, 1969). (In Norwegian).

A survey is given of current work at Institutt for Atomenergi, Norway, within the fields of instrumentation and automatic control. Special mention is given to larger projects, such as the development of a 3-dimensional dynamics model for BWR cores, in-core instrumentation work within the Halden Project, and computer control of the Halden Boiling Water Reactor. (auth) (Norway)

33575 TRACE SCANNING. Arrowood, J. L.; Groppe, W. A.; Lee, W. W. Jr. (to United States Atomic Energy Commission). U. S. Patent 3,453,050. July 1, 1969.

The evaluation of data recorded on film is facilitated by employing an electrical scanning system which is capable of accurately reading and recording the data. The spatial relationship on the film of a data line to a reference line is electrically measured by employing a train of timing pulses of a fixed frequency with the number of pulses between the data line and the reference line being indicative of the spacing between the lines. (AEC)

33576 SPARK COUNTER DATA ACQUISITION SYSTEM USED WITH A MAGNETIC SPECTROGRAPH. Fulbright, H. W.; Robbins, J. A. (Univ. of Rochester, N. Y.). Contract AT(30-1)-875. Nucl. Instrum. Methods, 71: 237-50(1969).

A data acquisition system based on the use of a sonic spark counter at the focal position of a magnetic spectrograph is described. The output of the spark counter is fed into a computer which processes the events on-line, presents a cathode ray display for continuous monitoring during experiments, controls the recording of the reduced data on magnetic tape, and, by use of an incremental recorder, on paper, in graphical form. Separate spectra are obtained, automatically separated, for protons, deuterons, ^{3}H, ^{3}He, and ^{4}He. The resolution is better than 1 mm. Counting rates up to 100/sec have been used. The system has been employed successfully in a number of experiments over a period of about two years. (auth)

33577 ION SOURCE WITH SIDE AND END WALLS HAVING INDEPENDENT POTENTIALS. Brown, Harmon W. (to Varian Associates). U. S. Patent 3,443,088. May 6, 1969. Filed Mar. 16, 1966.

A cycloidal mass spectrometer is disclosed. The mass spectrometer includes an improved ion source. The ion source includes a substantially hollow cylindrical chamber having a cylindrical side wall and a pair of disc shaped end walls. An electron beam is passed through the center of the chamber along a path falling in a midplane parallel to the plane of the end walls. The electron beam serves to ionize gas flowing into the ionizing chamber through one of the end walls to produce an ion beam which exits through a beam defining slot in the other end wall. The cylindrical side wall is operated at a potential intermediate and potentials applied to the end walls such that the ions are produced in a relatively strong accelerating field which rapidly accelerates the ions out of the ionizing beam path. By causing the ionizing beam to cross the ionizing chamber parallel to an equipotential plane in the central region of the ionizing chamber, the ions are produced in a region of uniform accelerating electric field and by electrons of a well-defined potential. This facilitates obtaining high resolution in the output of the spectrometer and facilitates determination of ionizing and dissociation potentials. Means are also provided for varying the beam potential. (Offic. Gaz.)

33578 SCINTILLATION OBSERVER FOR A SPECIMEN SUBJECTED TO RADIATION. Portal, Guy; Aouizerate, Marc (to Commissariat a l'Energie Atomique). U. S. Patent 3,443,094. May 6, 1969. Priority date Nov. 10, 1965, France.

A device for observing the scintillation characteristics of a specimen is described. The device is comprised mainly of a specimen-holding unit, a radiation source, and radiation detector. (B.G.D.)

33579 IMPROVEMENTS IN OR RELATING TO COLD-CATHODE DISCHARGE DEVICES. Maskell, Clifford William Alfred (to United Kingdom Atomic Energy Authority). British Patent 1,154,379. June 4, 1969. Filed Dec. 30, 1965.

Reference is made to cold-cathode discharge devices employed as electron sources, and in particular to such devices as used for the heat treatment of refractory materials. The device described has an anode mounted within or forming part of the interior wall of the envelope, and a hollow cathode formed at least partly of wire mesh mounted within the envelope, one wall of the cathode having an aperture. A further electrode is positioned in this aperture and defines a gap between its peripheral edge and the edge of the aperture through which the electron beam passes. The operating potential applied to the further electrode may be the same as, or positive or negative relative to, that applied to the cathode. Two devices based on this construction are described in detail. A conical beam of electrons is produced, converging to a focus at a point outside the cathode, the focus being variable by varying the electrode potentials. Water cooling may be employed. The electrode material may be stainless steel or tantalum. (UK)

33580 DIGITAL-COMPUTER PROCESSING OF SAMPLING-OSCILLOSCOPE DATA. Cohn, C. E. (Argonne National Lab., Ill.). Nucl. Instrum. Methods, 71: 349-52(1969).

A digital computer can process information from a sampling oscilloscope to average out noise and fluctuations on the observed waveform. (auth)

Radiation Effects on Instruments and Instrument Components

33581 THE EFFECTS OF RADIATION ON THE PARAMETERS OF FIELD EFFECT TRANSISTORS (SURVEY). Stenin, V. Ya. (Moscow Engineering-Physics Inst.). Prib. Tekh. Eksp., No. 2, 5-19(Mar.-Apr. 1969). (In Russian).

The change in physical properties and electric characteristics of field effect transistors with controlled p-n transition and transistors of the metal-dielectric-semiconductor type under the action of ionizing radiation and neutrons were examined. The mechanism of residual and transient effects was described. (71 references.) (tr-auth)

33582 THE EFFECT OF ELECTRONS WITH AN ENERGY OF 50 TO 1200 eV ON AgBr MICROCRYSTALS IN NUCLEAR EMULSIONS. Kuks, I. M. Zh. Nauch. Prikl. Fotogr. Kinematogr., 14: 19-30(Jan.-Feb. 1969). (In Russian).

Experimental data were obtained concerning the photographic effect of electrons with energies of 50 to 1200 eV on a single layer of prepared nuclear emulsions. The energy relations for the effect of electrons with single and multiple incidences in microcrystals were determined. Probability relations were found for the effect of exposure of the microcrystal to monoenergetic electrons. A comparison of results for the individual and collective effect of electrons on emulsion crystals shows that for the mechanism of photographic sensitivity to particle effects, the steric aspect, which is temporary, is more important. (tr-auth)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Basic Processes

Refer also to abstracts 33761 and 33835.

33583 (AD-684175) COATED CHARCOAL RADIOIMMUNOASSAY FOR PLASMA INSULIN. Strong, Guy M.; Logsdon, Donald F. Jr.; Green, James F. (School of Aerospace Medicine, Brooks AFB, Tex.). Nov. 1968. 13p. (SAM-TR-68-127). CFSTI.

A radioimmunoassay method using coated charcoal was developed as a simple, precise, and reproducible technic for measuring plasma insulin. Materials used included insulin-1251, guinea pig anti-insulin serum, and coated charcoal. Varying reagent volumes were tested to achieve an antibody concentration which would bind 60% to 80% of the labeled antigen. The radioimmunoassay consisted of three phases: addition of reagents and a 60-hour incubation period, separation of the antibody-insulin complex from the unbound insulin, and determination of activity and calculation of the insulin concentration. The fasting value found with 10 control subjects ranged from 12 to 72 micro-U/ml. This procedure is adaptable for use as a routine diagnostic test by most radioisotope laboratories. (auth) (USGRDR)

33584 (NSJ-tr-121) ANTITUBERCULOUS ACTIVITY OF γ-IODOPROPARGYL-o-TOLYL-ETHER AND ANALYSIS OF ITS IN VIVO METABOLISM BY DOUBLE LABELLING. Toyohara, Mareichi; Shigematsu, Akiyo; Inagaki, Hirokazu; Nomiya, Bunzo; Umemura, Koshiro. Translated from Radioisotopes (Tokyo), 15: No. 1, 47-52(1966). 14p. Dep.

Antituberculous activity of γ-iodopropargyl-o-tolyl-ether (M-1189) that was synthesized recently was studied in vitro and in vivo, and the in vivo degradation of the compound was observed using γ-iodopropargyl-β,γ-^{14}C-o-tolyl-^{3}H ether. The experimental results were as follows: M-1189 inhibited the growth of tubercle bacilli partially at 2 mcg/ml and completely at 8 mcg/ml in the Kirchner serum media. The therapeutic effect on experimental tuberculosis in mice was demonstrated following the oral administration of 1 mg/day/mouse for three weeks, but the effect was inferior to that of 1314 TH, a secondary antituberculous drug. Delayed toxicity was evident following continuous administration of M-1189. Therefore it is now difficult to employ this compound clinically as an antituberculous drug for human tuberculosis. In order to know the degradation process of M-1189 in internal organs after oral administration, 0.5 ml of emulsion containing 4 mg of γ-iodopropargyl-β,γ-^{14}C-o-tolyl-^{3}H ether (M-1189*) was given orally to each mouse. Radioactivity from ^{3}H was detected in the blood of each mouse at a certain time after administration and radioactivity from ^{3}H or ^{14}C was detected in each organ as well. Radioactivity of the propargyl portion of M-1189* reached a maximum in organs (spleen, liver, lung, stomach, intestine, and kidney) after 3 to 6 hr after administration, and then decreased exponentially. On the other hand, radioactivity of the o-tolyl portion of M-1189* also reached a maximum in organs at the same time with the propargyl portion and once decreased, but again increased after 72 to 96 hr. These facts suggest that the biological activity of M-1189* will be retained in the organs for 3 to 6 hr after oral administration, but will decay after that because of degradation and the occurrence of delayed toxicity owing to the accumulation of the o-tolyl portion. (E.R.B.)

33585 STRUCTURAL AND FUNCTIONAL PROPERTIES OF POLYTENE NUCLEI ISOLATED FROM SALIVARY GLANDS OF DROSOPHILA HYDEI. Berendes, Hans D.; Boyd, James B. (Max-Planck-Institut fuer Biologie, Tuebingen, Ger.). J. Cell Biol., 41: 591-9(May 1969).

Salivary gland nuclei of Drosophila hydei, isolated by a modification of the procedure described by Boyd et al., retain their normal morphology during the isolation and subsequent incubation procedure. RNA synthesis was studied in isolated nuclei by biochemical and cytological techniques. In radioautographs 70% of the nuclei displayed a distribution of labeled RNA over the nuclear constituents similar to the distribution obtained after in vivo incorporation of radioactive precursor. Chromosome puffs and the nucleoli were specifically labeled. The remaining 30% of the nuclei showed a weak to very weak incorporation of radioactive precursor. In these nuclei most of the radioautographic grains were concentrated over the nucleolus, and a few grains were randomly distributed over the chromosomes. Actinomycin D and the absence of ATP, GTP, and CTP in the medium inhibited incorporation of radioactive precursor. The radioactive product was sensitive to combined pronase and RNase digestion. Addition of E. coli RNA polymerase to the incubation medium enhanced the specific labeling over the puffed regions. The sedimentation behavior of the RNA synthesized in isolated nuclei was different from that of RNA synthesized during a 20 min pulse of radioactive precursor administered to whole glands in vivo and in vitro. Neither the steroid ecdysterone nor a temperature treatment was effective in inducing new puffs in isolated nuclei. (auth)

33586 CONSTANT MONITORING OF PLASMA LUTEINIZING HORMONE BY RADIOIMMUNOASSAY IN INDIVIDUAL RATS FOLLOWING INJECTION OF HYPOTHALAMIC EXTRACT. Gay, Vernon L.; Rebar, Robert W.; Midgley, A. Rees Jr. (Univ. of Michigan, Ann Arbor). Proc. Soc. Exp. Biol. Med., 130: 1344-7(Apr. 1969).

Samples of whole blood were collected continuously over 5 min intervals for a period of several hours from individual, nonanesthetized, cannulated, ovariectomized, estrogen–progesterone-treated rats. Plasma LH concentrations were determined by radioimmunoassay of the whole blood after adjustment for hematocrit. The blood cells influenced the resulting measurements only to the extent to which serum volume was displaced. After the injection of hypothalamic extract, plasma LH concentrations increased 4- to 6-fold within 10 min. Plasma LH concentrations then returned to, but did not fall below, preinjection values. The rate of hormone disappearance from the plasma suggests that, under these conditions, LH release in response to hypothalamic extract is limited to the first few minutes after injection. (auth)

33587 DETERMINATION OF CALCIUM RETENTION IN THE RAT BY WHOLE-BODY LIQUID SCINTILLOMETRY. Bhatti, M. C.; Shaw, S. M.; Christian, J. E.; Miya, T. S. (Purdue Univ., Lafayette, Ind.). J. Pharm. Sci., 58: 502-3(Apr. 1969).

The whole-body retention time and the effects of parathyroid extract on retention of calcium in rats were determined. Liquid scintillography and urine activity analysis were used to determine the retention time following intraperitoneal injection of ^{47}Ca. Parathyroid extract was administered to one group of rats in each determination and one group was injected with physiological saline as a control. The rats receiving parathyroid extract showed a significant decrease in calcium retention. Whole-body liquid-scintillation counting proved to be a sensitive method of determining changes in calcium level. Whole urine sample counting required larger quantities of ^{47}Ca. (E.R.B.)

33588 RELATIONSHIP BETWEEN HUMAN CHORIONIC SOMATO-MAMMOTROPINE HORMONE AND THYROSTIMULINE IN BIOLOGICAL AND RADIOIMMUNOLOGICAL ASSAYS. Genazzani, A. R.; Lemarchand-Beraud, Th. (Clinica Ostetrica e Ginecologica, Siena, Italy. Univ., Lausanne, Switzerland). Experientia, 25: 419-20(Apr. 15, 1969).

The possibility of an interference of human chorionic somatomammotropine hormone (HCSM) or of a cross reaction between HCSM and TSH in radioimmunological and biological assays was investigated with respect to TSH having similar amino acid sequences to HCSM, which would react with the antiserum in the radioimmunoassay, or that HCSM had some TSH-like biological activity. Methodology and results are described and discussed. It was concluded that no cross reaction occurred between HCSM and TSH in radioimmunoassay. The HCSM tested in the TSH radioimmunoassay showed a slight TSH-like activity of 0.27 mU of TSH/mg of HCSM in the bovine radioimmunoassay and of 0.19 mU/mg of HCSM in the human TSH system, and of 0.30 mU/mg of HCSM in the biological assay. This slight TSH-like activity was not responsible for the increased TSH level found during pregnancy. (C.O.)

33589 EFFECT OF DIVALENT CATIONS ON THE UPTAKE AND OXIDATION OF SUBSTRATES BY PSEUDOMONAS AERUGINOSA. Eagon, R. G.; Asbell, Mary A. (Univ. of Georgia, Athens). J. Bacteriol., 97: 812-19(Feb. 1969).

Evidence is presented that Zn^{2+}, UO_2^{2+}, and certain other multivalent cations inhibit the uptake and oxidation of substrates by Pseudomonas aeruginosa and by other bacterial cells. Tris(hydroxymethyl)aminomethane augmented this effect. Inhibition by these multivalent cations was prevented by incubation of cellular suspensions of P. aeruginosa in phosphate buffer. In the case of other microorganisms, incubation in the presence of ethylenediaminetetraacetate also prevented the inhibition. Inhibition by Zn^{2+}

of the uptake and of the oxidation of substrates was reversed by the addition of Mg^{2+}. Zinc (2+) was shown to inhibit noncompetitively the uptake of the three substrates studied, L-alanine, D-glucose, and citrate. (M.M.B.)

33590 THE STRUCTURE OF A URINARY METABOLITE OF PROSTAGLANDIN $F_{2\alpha}$ IN MAN. Granstroem, Elisabeth; Samuelsson, Bengt (Royal Veterinary Coll., Stockholm). J. Amer. Chem. Soc., 91: 3398-3400(June 4, 1969).

Intravenous injections (35 mg) of tritium-labeled prostaglandin $F_{2\alpha}$ were administered to female subjects. Unlabeled prostaglandin $F_{2\alpha}$ was administered by intravenous infusion to increase the amount of urinary metabolite obtained. Urine was collected until no more radioactivity was detected (5 hr). Ethyl acetate extracts of the urine were obtained and purified by reversed phase partition chromatography. Of the two radioactive peaks obtained, the first (110 to 180 ml of effluent) was esterified with diazomethane and purified by reversed-phase partition chromatography. Of the two radioactive peaks thus obtained, the second (16) was further treated and analyzed by gas-liquid phase chromatography and mass spectrometry. The results of these analyses are presented. (E.R.B.)

33591 RADIO-TRACER TECHNIQUE IN DETERMINATION OF ERYTHROCYTE OSMOTIC FRAGILITY. Banerjee, R. N.; Gulliani, G. L. (INMAS, Delhi). Indian J. Med. Res., 55: 209-14(1967).

Use of ^{51}Cr labeled red blood cells in determining the erythrocyte osmotic fragility is described. Results of osmotic fragility test carried out in 48 control subjects and 21 patients suffering from various hematological disorders are reported. The technique is simple and can be carried out simultaneously with the other radioisotopic diagnostic test for hemolytic anemias. (Indian Sci. Abstr.)

33592 RADIO-RETENTION ELECTROPHORESIS: A QUANTITATIVE AND SPECIFIC PROCEDURE FOR ESTIMATION OF SINGLE PROTEINS IN THE NANOGRAM RANGE. Habermann, E.; Raeker, K.-O.; Arndts, D. (Justus Liebig-Univ., Giessen, Ger.). Klin. Wochensch., 46: 46-7(Jan. 1, 1968). (In German).

A procedure is described for estimation of ng amounts of antigens, that combines electrophoresis in agar containing the antibody and radioretention electrophoresis autoradiography. Techniques and the range of application of the method with ^{131}I-albumin are described, and some results of blood level determinations are reported. Amounts of protein from 50 to 500 ng are detectable. The efficiency of the procedure is limited by the solubility of the antigen-antibody precipitate. The procedure is useful in radioimmunoassay procedures, Evaluation of differences between native and ^{131}I-labeled albumin, etc. (BBB)

33593 IN VITRO BIOASSAY OF SERUM THYROTROPHIN (TSH) IN THE NORMAL RAT. Bourke, J. R.; Hawker, R. W.; Manley, S. W. (Univ. of Queensland, Brisbane). Endocrinology, 84: 1292-5(May 1969).

Rat serum TSH was assayed using the discharge of unbound $^{131}I^-$ from guinea pig thyroid slices. Nonspecific responses occurred with untreated rat serum. Filtration of serum on Sephadex G-25 removed the interfering factors, permitting the estimation of rat serum TSH levels with quantitative recovery. Mean normal serum levels were 6.5 and 4.7. International mU/100 ml (males and females, respectively, the difference being nonsignificant). Serum activity was reduced by antiserum to 0.18 mU/100 ml and by T_4 treatment (75 μg daily for 5 days) to 0.25 mU/100 ml, these residual responses lying close to the end-point of the regression. Prior oophorectomy had no significant effect upon the serum activity of T_4 treated rats. Propylthiouracil (0.1% in drinking water for 102 days) elevated the mean level to 93 mU/100 ml. Departures from parallelism with International Standard TSH occurred in 14 of 40 assays of normal rat serum. No departures were detected in 18 such assays against a rat pituitary fraction (potency 1.5–2 U/mg) prepared as a local standard. (auth)

33594 DETERMINATION OF TOTAL BODY WATER BY DEUTERIUM OXIDE DILUTION AND CRYOSCOPY. Walsh, G. C.; Carruthers, B. M.; Seraglia, M.; Olson, Marlene (Shaughnessy Hospital, Vancouver, Can.). J. Lab. Clin. Med., 72: 836-41(Nov. 1968).

Total body water was determined in human subjects by administering deuterium oxide (D_2O) orally as the tracer substance and after equilibrium has occurred, determining the dilution of the tracer by measuring the change in freezing point of the serum water with a sensitive osmometer. Error from variations in base-line readings of the cryoscope was minimized by straddling the serum sample with a control of double distilled water. The administration of D_2O orally rather than intravenously did not appear to add another variable in the determination of total body water. Variation in total body water in nine subjects considered to be normal in respect to fluid and electrolyte balance over a period of 3 to 6 weeks was determined. (auth)

Metabolism, Physiology, and Toxicology

Refer also to abstracts 33428, 33455, 33664, 33699, 33700, 33719, 33755, 33764, 33775, 33784, and 33882.

33595 (PHS-PUBL.-1809, pp 59-88) RADIONUCLIDE TOXICOLOGY LABORATORY. Stara, Jerry F. (Bureau of Radiological Health, Rockville, Md.).

The Radionuclide Toxicology Laboratory studies primarily the toxicity or other biological effects of specific hazardous radioisotopes. The core project is the study of the effects of ^{89}Sr on the hematopoietic system of the cat. Studies related to the core project that are summarized are as follows: status and production of the cat colony; qualitative evaluation of the embryonic skeleton in cats; placental transfer of ^{85}Sr and ^{45}Ca in the cat; metabolism of ^{85}Sr in cats; ^{85}Sr distribution and weights of organ systems in chronically labeled cats; analysis of stable Sr and Ca in skeletal tissues of cats; dosimetry of ^{90}Sr in skeletal tissues of cats; lethal effects of ^{89}Sr in cats; localization of ^{131}I-labeled tetracycline in tumors using scintiscanning; experimental myxedema in cats produced by ^{131}I; maternal-fetal ^{131}I relations in the guinea pig; distribution of carrier-free and ^{90}Mo-labeled milk in cats; carcinogenic effects of deposited radioactive particles in the lung; and investigation of α particles and tobacco smoke synergism. (C.O.)

33596 BEHAVIOR OF ^{86}Rb IN NORMAL RAT MYOCARDIAL TISSUE AND IN TISSUE INJURED BY ISCHAEMIC NECROSIS. Aschenbrenner, V.; Mestan, J.; Turek, Z. (Lab. of Graphical Diagnostics, Prague. Karlova Univ., Prague). Physiol. Bohemoslov., 17: 431-6(1968).

Myocardial necrosis inhibited the extraction of ^{86}Rb from the blood into the myocardial tissue and its re-release from the affected areas into the blood. This change was detected in rats with myocardial necrosis induced by ligature of the left coronary artery and by the intramuscular administration of isoprenaline. (auth)

33597 INHIBITION OF RADIOSTRONTIUM ABSORPTION BY ALUMINUM PHOSPHATE GEL IN MAN AND ITS COMPARATIVE EFFECT ON RADIOCALCIUM ABSORPTION. Spencer, Herta, Lewin, Isaac; Belcher, Mary J.; Samachson, Joseph (Veterans Administration Hospital, Hines, Ill.). Contract AT(11-1)-1231-42. Int. J. Appl. Radiat. Isotop., 20: 507-16(July 1969).

Studies performed under constant and strictly controlled dietary conditions showed that a single oral dose of aluminum phosphate gel, ranging from 300 to 100 ml, given immediately prior to an oral dose of ^{85}Sr, decreased the absorption of ^{85}Sr in man by an average of 87.5%. An amount of 100 ml aluminum phosphate gel was found to be as effective as 300 ml in decreasing the absorption of ^{85}Sr. The decrease in ^{47}Ca absorption was considerably less than the decrease in ^{85}Sr absorption, averaging 37.8%. The disproportionate decrease in ^{47}Ca and ^{85}Sr absorption in the aluminum phosphate gel studies resulted in a marked increase in the $^{47}Ca/^{85}Sr$ discrimination ratio of the absorption and of the plasma levels of these radioisotopes. A comparison of the absorption of ^{47}Ca and ^{85}Sr determined in the same patients in the aluminum phosphate gel studies showed an average $^{47}Ca/^{85}Sr$ discrimination ratio of 12.9 as compared to a value of 1.62 in the control studies. The aluminum phosphate gel studies have shown that this non-toxic, well-tolerated substance is effective in inhibiting the absorption of acutely ingested radiostrontium in man and decreases the absorption of ^{47}Ca to a considerably lesser extent. (auth) (UK)

33598 MEASUREMENT OF GLOMERULAR FILTRATION RATE USING CHELATED ^{169}Yb. Hosain, Fazle; Reba, Richard C.; Wagner, Henry N. Jr. (Johns Hopkins Medical Institutions, Baltimore). Int. J. Appl. Radiat. Isotop., 20: 517-21(July 1969).

Ytterbium-169 chelated with diethylenetriaminepentaacetic acid (^{169}Yb-DTPA) was evaluated for possible use as a glomerular substance. The radionuclide has a high proton yield with complex gamma ray spectrum. It has a physical half-life of 32 days, but less than 1% of intravenously injected chelated complex is retained in the body, which limits the radiation exposure. Gel filtration studies showed that ^{169}Yb-DTPA complex did not bind to plasma proteins and was excreted unchanged in the urine. The clearance rate of the complex was found to be independent of the plasma concentrations of Yb-DTPA. The renal clearance of ^{169}Yb-DTPA was compared simultaneously with that of ^{14}C-

inulin in dogs, normal human subjects and patients with renal disease. Nearly identical results were obtained with both the agents over a wide range of glomerular filtration rate. The radiation doses due to different glomerular agents containing ^{131}I, ^{125}I, ^{57}Co, ^{99m}Tc, ^{51}Cr, ^{113m}In, ^{140}La, and ^{169}Yb were calculated for normal and impaired renal conditions. ^{169}Yb–DTPA was found to deliver comparatively low radiation doses. It is believed to be a safe, inexpensive and effective new agent for the measurement of glomerular filtration rate. (auth) (UK)

33599 ^{33}P: A SUPERIOR RADIOTRACER FOR PHOSPHORUS? Robinson, J. R. (Agricultural Research Inst., London, Ont.). Int. J. Appl. Radiat. Isotop., 20: 531-40(July 1969).

Phosphorus-33 has half-life and energy properties which should render it superior to ^{32}P as a radiotracer for phosphorus in most biological applications. It should be particularly useful in autoradiography, in long-term experiments, in applications where sensitivity to radiation is high, and in dual labelling of intermediates containing more than one phosphorus atom. Advantages and limitations in the use of ^{33}P are reviewed, with a consideration of price, half-life, energy, radioisotopic purity, and methods of measurement. Determination of the ^{32}P content in ^{33}P is used to demonstrate Geiger, liquid scintillation and Cherenkov techniques for counting these radioisotopes. (auth) (UK)

33600 NOTES ON PREPARATION OF INDIUM COLLOIDS. Filbee, J. F.; Maxwell, I. D. (Halifax Infirmary, Nova Scotia. Dalhousie Univ., Halifax, Nova Scotia). Int. J. Appl. Radiat. Isotop., 20: 552-3(July 1969).

It was shown that good labelling of the lungs can be achieved using gelatin particles labelled with Indium-113m. It was also shown that by simple, rapid and reliable procedures good labelling of the liver, spleen, and blood pool can be achieved. It was further observed that in colloids of this general type specification must include a more precise description of gelatin than gelatin USP. (auth) (UK)

33601 DEPOSITION AND INITIAL TRANSLOCATION OF INHALED PARTICLES IN SMALL LABORATORY ANIMALS. Thomas, Randi L. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Contract AT(29-2)-1013. Health Phys., 16: 417-28(Apr. 1969).

Approximately 1000 mice, rats, and guinea pigs were exposed to aerosols contaminated with ^{144}Ce, ^{137}Cs, ^{131}I, or ^{85}Sr to determine initial whole-body deposition and distribution in tissues. Aerosol vector was altered, in both generator solution concentration and chemical compound, to produce particle size distributions ranging from 0.33 μ to 3.7 μ activity median aerodynamic diameter (AMAD) and different relative solubilities. Accurate individual deposition values were obtained by recording the respiratory pattern of each animal during exposure. In rats and guinea pigs initial total deposition increased with increased particle size; however, with particle size distributions from 0.7 μ to 2.5 μ AMAD, mice showed decreased deposition with larger particles. Initial distribution of inhaled materials in tissue was determined to be a function of particle size and solubility. (auth) (UK)

33602 ^{90}Sr CONCENTRATION FACTORS OF LAKE PLANKTON, MACROPHYTES, AND SUBSTRATES. Kalnina, Z. (Inst. of Biology, Riga); Polikarpov, G. Science, 164: 1517-19 (June 27, 1969).

The ratio of concentration of strontium-90 in living and inert lake components to that in lake water (concentration factors) was determined for plankton, macrophytes, and substrates in eutrophic, mesotrophic-eutrophic, and dystrophic Latgalian lakes. Concentration factors of strontium-90 in aquatic organisms and substrates are higher in a dystrophic lake than in the other types. (auth)

33603 ABSORPTION OF ^{45}Ca AND ^{89}Sr FROM THE ABOMASUM OF THE CALF. Chandler, P. T.; Cragle, R. G.; Bacon, J. A.; Wykoff, M. H. (Univ. of Tennessee, Oak Ridge). Contract AT(40-1)-Gen-242. Proc. Soc. Exp. Biol. Med., 130: 1257-9 (Apr. 1969).

In vivo experiments, using 12 anesthetized calves, were conducted to determine the extent of abomasal absorption of ^{45}Ca and ^{89}Sr. In two experiments, one with milk-fed calves and another with hay- and grain-fed calves, a large amount of variation in absorption was noted. This was attributed to a lack of mixing of the isotope with abomasal ingesta. Variability was reduced in a third experiment by increasing the dose volume to 225 ml. An average of 20.8 ± 3.1% of an administered dose of ^{45}Ca, and 3.2 ± 3.0% of ^{89}Sr were absorbed from the abomasum within 25 min. These estimates were based on the amounts of isotope recovered from ingesta and abomasal tissue of four animals and is substantiated by the rapid appearance of ^{45}Ca in venous blood drained from the abomasum. (auth)

33604 MATERNAL–FETAL TRANSPORT AND DISTRIBUTION OF ^{59}Fe AND ^{131}I IN HUMANS. Dyer, N. C.; Brill, A. B.; Glasser, S. R.; Goss, D. A. (Vanderbilt Univ., Nashville). Amer. J. Obstet. Gynecol., 103: 290-6(Jan. 15, 1969).

Radioisotope transport studies were performed on pregnant women receiving therapeutic abortions at gestational age varying from 11 to 22 weeks. Each was given 10 μCi of ^{59}Fe intravenously as ferrous citrate and 50 μCi of ^{131}I orally as sodium iodide, about 18 hr prior to operation. The accumulation factor (ratio of fetal organ radionuclide concentration to the total fetus radionuclide concentration) was used to determine the fetal organ with greatest power of concentration. With ^{131}I, the accumulation factor was over 3000 times larger for the thyroid than for other fetal organs. The accumulation factor for ^{59}Fe was about 200 times larger for the liver and about 50 times larger for the spleen than for other fetal organs. Calculations of the radiation dose to the fetus for the two radioisotopes were also made. The dose to the fetal thyroid from ^{131}I given the mother increased sharply with increasing gestational age. It increased from about 1.3 Rad/μCi at the 14- to 15-week stage to 6.5 Rad/μCi by 22 weeks. Thus therapeutic use of ^{131}I in a pregnant woman after the 12th to 14th week would be devastating to the fetal thyroid. A typical 5-mCi therapy dose of ^{131}I given the mother would be about 6500 Rad. (BBB)

33605 ^{137}Cs UPTAKE BY OAT PLANTS AS RELATED TO THE SOIL FIXING CAPACITY. Cummings, S. L.; Bankert, L.; Garrett, A. R. Jr.; Regnier, J. E. (Public Health Service, Montgomery, Ala.). Health Phys., 17: 145-8(July 1969).

Soils can retain ^{137}Cs in a fixed state which is relatively unavailable for plant absorption. This is largely attributed to vermiculite or related minerals capable of forming a relatively stable collapsed structure when saturated with Cs^+, Rb^+, K^+, or NH_4^+ ions. Soils are, however, variable in their capacity for fixing cesium. A significant correlation was obtained between the oat uptake of ^{137}Cs and the soil fixing capacity. Oat uptake decreased as the soil fixing capacity increased. The results suggest that the low fixing capacity of the Florida soils is an important factor giving rise to the higher than average ^{137}Cs concentrations in the milk of Tampa, Florida area. (auth) (UK)

33606 FATE OF ^{212}Pb INHALED BY HUMAN SUBJECTS. Hursh, J. B.; Schraub, A.; Sattler, E. L.; Hofmann, H. P. (Justus Liebig-Univ., Giessen, Ger.). Health Phys., 16: 257-67(1969). (UR-49-937).

Ten human subjects inhaled ^{212}Pb carried on natural aerosols. Deposition in the lung varied from 14 to 45% of the amount inhaled. Clearance from the lung to the systemic tissues occurred with an estimated half-time of 6.5 hr. The average 24-hr urinary excretion of ^{212}Pb was 2.8 ± 0.15% of the body content. The total loss by fecal excretion adjusted to zero time averaged 3% body content. The lead absorbed from the lungs into the blood is in part fixed by the circulating red cells and in part distributed to other tissues. The red cell ^{212}Pb burden grows to a steady state level which averages 50% of the total body burden. The results are interpreted to indicate that the clearance of radon daughters from the lung parenchyma by absorption into the blood has little dosimetric significance, whereas, in the case of thoron daughters, the average lung dose is reduced to less than half. (auth)

33607 DIETARY ANTIBIOTICS AND THE ABSORPTION OF ^{65}Zn AND ^{131}I-LABELED OLEIC ACID. Turk, D. E. (Clemson Univ., S. C.). Poultry Sci., 47: 1768-71(Nov. 1968).

At weekly intervals, 3 to 6 weeks after male chicks had access to an experimental ration, ^{65}Zn and ^{131}I-labeled oleic acid were orally administered to birds randomly selected from each experimental treatment and the appearance of the isotope in the bloodstream was followed. Three trials were performed in which duplicate groups of the 12-day-old chicks were fed corn-soybean meal starter rations containing the following antibiotics: none, chlortetracycline at 55 mg or 220 mg/Kg, oxytetracycline at 55 mg/Kg, erythromycin at 19.8 mg/Kg, or bacitracin at 55 mg/Kg. In all three trials, significant growth responses to the antibiotics were obtained. The antibiotics tested did not affect the amount of either ^{65}Zn or ^{131}I absorbed within an 8-hr period after radioisotope administration nor did they affect the time required for the absorption of isotopes. It was concluded that the growth response observed when antibiotics were fed was not due to improved absorption of ^{65}Zn and ^{131}I-oleic acid. (BBB)

33608 THE INFLUENCE OF HEAVY WATER ON THE STATIONARY CURRENT VOLTAGE CHARACTERISTIC OF THE RANVIER NODE. Mueller-Mohnssen, H.; Albrecht-Buehler, G. (Institut fuer Biologie der Gesellschaft fuer Strahlenforschung

mbH, Neuherberg, Ger.). Pfluegers Arch. - Europ. J. Physiol., 305: 65-75(1969). (In German).

Effects of D_2O on bioelectric activity of Ranvier nodes in frog (Rana esculenta) motor nerve were studied. The stationary current voltage was measured by a 3-electrode arrangement in surviving individual fibers of sciatic nerve. Replacement of H_2O by D_2O (99.75%) in the extracellular Ringer's solution led to changes in the voltage relation of the Ranvier node in that the positive resistance was increased by a factor of 1.2, and the transition region of the limiting values of resistance was shifted 20 mV towards depolarizing potentials. As a result of these 2 changes an increase of the negative differential resistance occurred which was observed if the membrane potential exceeded +20 mV. These changes were observed independently of whether the current was carried by K (or Rb), or (during veratridine depolarization) also by Na, Li, or NH_4. This effect of D_2O was comparable to the influence of increased extracellular concentration of H and Ca as well as to increased osmolarity. All led to increased threshold voltage of the action potential according to the shift of transition region to more positive potentials. An explanation of the dominant influence of D_2O based merely on the differences in physicochemical properties between H_2O and D_2O Ringer's solution was ruled out. The results are explained on the basis of consequences of an influence of solvent on the excitable membrane itself. This interpretation is supported by the observation that the microscopic pattern of nerve fibers treated with D_2O solutions changed in a definite way. (BBB)

33609 DEPENDENCE OF RADIOSTRONTIUM UPTAKE BY PEA AND LUPIN ON THE CONTENT OF CALCIUM IN THE NUTRIENT SOLUTION. Balcar, J.; Breszinova-Doskarova, Alena; Eder, J. (Inst. of Experimental Botany, Prague). Biol. Plant., Acad. Sci. Bohemoslov., 11: 34-40(1969).

It was found that in lupine (Lupinus albus) and pea (Pisum sativum) the uptake of ^{89}Sr from Knop's nutrient solution is significantly increased from a solution with decreased Ca content ($^1/_{10}$ of the normal content) and is slightly decreased from a solution with higher Ca content (150% of the normal content). The pea, a calciphile, absorbs ~50% more Ca than the calciphobe lupine, and shows accordingly 50% radiostrontium loss. The pea plant more strongly blocks the translocation of radiostrontium from roots to above-ground parts, as shown by the higher discrimination factor of the pea (i.e., by the ratio of sp act. of $^{89}Sr/g$ Ca of roots to overground parts). The presence of chlorine in the nutrient solution decreases the content of radiostrontium per gram of dry matter, both in pea and lupine. Radiostrontium is absorbed quickly by both species of plants and is autoradiographically detectable as early as 2 hr after the introduction of radiostrontium to the nutrient solution. (BBB)

33610 A NEW METHOD FOR THE DETERMINATION OF CALCIUM FLUXES IN THE FROG HEART BY MEANS OF HIGH PRECISION MEASUREMENT OF ^{45}Ca CONCENTRATIONS. Niedergerke, R.; Page, S. (Univ. Coll., London). Pfluegers Arch.-Europ. J. Physiol., 306: 354-6(1969).

For detailed study of Ca movements in cardiac tissue, a procedure was developed which allowed the concentrations of ^{45}Ca in aqueous samples to be determined with unusually high precision, i.e., with an overall error of about 0.1%. The technique and its applicability to Ca flux measurements in frog heart ventricles are described. Heart ventricles of Rana pipiens were perfused internally with small volumes (about 700 µl) of ^{45}Ca-labeled Ringer's fluid for consecutive periods lasting 2 to 10 min or longer. During these periods, small changes in Ca content of these fluid volumes occurred, of magnitude depending on the activity of the heart, and these changes were used to measure the uptake or release of ^{45}Ca by the tissue. It was thereby possible to follow tracer movement in the intact ventricle, free from artifacts due to damaged tissue, known to absorb considerable amounts of Ca. Another advantage of the procedure is that interference by Ca in extracellular spaces and on tissue surfaces is largely avoided because these superficial regions are saturated with ^{45}Ca at an early stage of the experiment and thenceforth no longer contribute to the change in ^{45}Ca which is determined. Since the concentration changes usually amount to <1 to 2% of the total ^{45}Ca in the fluids, it is necessary to measure the concentration of each sample with the low error of ~0.1%. Details of the procedure are given. (BBB)

33611 RELATIONS BETWEEN FEMUR DENSITY AND ^{85}Sr UPTAKE IN BIPEDAL RATS. Nilsson, Bo E. R.; Saville, Paul D. (Hospital for Special Surgery, New York). Acta Orthop. Scand., 39: 433-8(1968).

When rats sustain a fracture of the tibia, the ipsilateral femur grows slower than the contralateral femur and the 24-hr uptake of radiostrontium on the fractured side is greater than that in the larger femur on the uninjured side. However, uptake is the same as that in a femur of the same volume and density from a smaller rat. This suggests that bone density rather than bone formation governs the uptake of radiostrontium. To test this point further, changes were made in the relations between body weight and bone density by raising bipedal rats, which have larger, denser, and stronger femora than normal rats of the same weight. The ash weight density, and volume of the femur were a linear function of body weight both in the controls and in the bipeds but at any given body weight, the bipeds had significantly more ash. The sp act. of injected ^{85}Sr was a negative exponential function of bone density and at any given bone density the sp. act. was identical in both groups. Thus, bipedal femora are larger than controls of the same weight but they have a normal amount of ^{85}Sr for bones of their density, indicating that the relation of ash content to volume and of uptake of ^{85}Sr to density were not influenced by the changes of femur growth introduced by bipedalism. (BBB)

33612 INFLUENCE OF BODY BURDEN OF RADIOMERCURY ON RADIATION DOSE. Phillips, R.; Cember, H. (Northwestern Univ., Evanston, Ill.). J. Occup. Med., 11: 170-4(Apr. 1969).

An experiment was designed to test the hypothesis that the elimination rate of a pharmacologically active substance is dependent upon the body burden. Four groups of 16 female rats each were injected intraperitoneally with isotopically tagged $HgCl_2$ at doses of 1, 5, 10, and 50 µg Hg/100 g body weight. Whole-body counting was performed for 100 days. Excreta was collected daily and analyzed for mercury. The rate of elimination increased with increasing dose. As the dose increased the relative amount of mercury eliminated through the urinary tract increased. The results support the hypothesis that there may be a class of elements that are eliminated at a rate dependent upon the body burden. The specific activity of the isotope must be considered when calculating the maximum allowable body burden of radioactive mercury. (W.M.B.)

33613 DISCRIMINATION BETWEEN ^{90}Sr AND ^{137}Cs IN LAYING HENS FOLLOWING INGESTION OF CONTAMINATED FOOD. Nezel, K. (Federal Research Inst. for Small Animal Studies, Celle, Ger.). Arch. Gefluegelk., 32: 286-97(1968). (In German).

After feeding of Leghorn hens with a feed contaminated with ^{90}Sr and ^{137}Cs over a period of one and two months, the discrimination of the $^{137}Cs/K$ and $^{90}Sr/Ca$ retention in blood, meat, bones, feathers, shell, albumen, yolk, and feces was estimated with regard to these relations in the feed. The excretion of these radionuclides in feces and eggs was also observed. (auth)

33614 EXPERIMENTAL STUDIES ON THE TRANSFER OF ^{65}Zn IN HIGH CONCENTRATION BY EUPHAUSIIDS. Small, Lawrence F. (Oregon State Univ., Corvallis). J. Exp. Mar. Biol. Ecol., 3: 106-23(Jan. 1969).

The uptake and elimination of ^{65}Zn by Euphausia pacifica, in clean sea water and in several concentrations of radioactive phytoplankton food, were measured at 10°C. Time schedules simulating those which vertically migrating euphausiids would spend in and out of a hypothetical ^{65}Zn pool at the sea surface at different seasons of the year in temperature latitudes were used. From the total ^{65}Zn body burdens reached at any time, and on the basis of the mechanisms and rates of loss of ^{65}Zn in radioactive and nonradioactive water, transfer of ^{65}Zn via euphausiids from the hot surface pool to nonradioactive water below were assessed. With initial concentrations of 25 µCi $^{65}Zn/l$, equilibrium body burdens were achieved in clean seawater in about four days under all time schedules. The level of equilibrium body burden was a function of time schedule (time spent in the radioactive solution). In radioactive food, equilibrium body burdens were not reached in five days. When uptake was from labeled food, elimination was from fecal pellet deposition as well as molting and exchange. Molting, exchange, and fecal pellet deposition represented different percentage losses from total body burden, depending largely upon the time the animal spent in and out of ^{65}Zn and the source of ^{65}Zn (water or food). (BBB)

33615 CONTENT AND DISTRIBUTION OF STABLE STRONTIUM AND ^{226}Ra IN HUMAN SKELETONS FROM WISCONSIN DECEDENTS 1957-61. Martin, Alex (Public Health Service, Washington, D. C.). Brit. J. Radiol., 42: 295-8(Apr. 1969).

A large collection of essentially complete human skeletons provided an opportunity for simultaneous measurement of stable strontium and ^{226}Ra in a group of 75 subjects. The skeletons were from Wisconsin, U.S.A., residents who died during the period 1957 to 1961 and whose ages at death ranged from 24 to 95 years (average ~70 years). ^{90}Sr was not measured because estimated levels on the order of 0.1 pCi/g calcium were too low to permit adequate comparisons, particularly for smaller bone categories. Stable

strontium and ^{226}Ra were determined in midsections of the combined tibiae and fibulae from each of the 75 skeletons. Their frequency distributions were found to be log-normal. Concentrations varied from 0.29 to 2.20 mg Sr/g Ca (log-mean = 0.51 mg Sr/g Ca) and from 13 to 112 fCi ^{226}Ra/g Ca (log-mean = 33 fCi ^{226}Ra/g Ca). There was no statistical correlation between strontium and ^{226}Ra levels. To evaluate the relative distribution of strontium and ^{226}Ra within these skeletons, 19 component parts (excluding teeth) from three of the 75 were analyzed. Stable strontium and ^{226}Ra concentrations were found to be nearly uniform within any one skeleton. Although the levels of ^{226}Ra in long bone ends were only slightly higher and the concentrations of strontium slightly lower than in corresponding long bone shafts, the differences were statistically significant. While unusually high levels of strontium and ^{226}Ra are reported in some Wisconsin municipal water supplies, subjects whose bones contained the highest concentrations of these substances did not consume such water. Findings in this report are compared with those from similar studies. (auth)

33616 IN VIVO ^{32}P INCORPORATION INTO ACID-SOLUBLE NUCLEOTIDES OF RAT SMALL INTESTINE. Zhivkov, V. Compt. Rend. Acad. Bulg. Sci., 21: 1121-3(1968).

Male albino Wistar rats of 150 to 200 g were injected intraperitoneally with 0.1 mCi/100 g of $Na_2H^{32}PO_4$ (carrier-free). The animals were killed by decapitation at various times after treatment. The small intestines were removed, opened, washed with ice cold saline, dried, and homogenized with perchloric acid in the cold. Nucleotides were obtained and separated by chromatography after adsorption on charcoal and elution with pyridine in ethanol, and identified spectrophotometrically. Inorganic phosphate and radioactivity levels were determined as well for each sample. Results are shown in tabular form, giving the relative molar specific activity of the nucleotides at the various times of death. For adenosine, guanidine, and uridine phosphates the rate of uptake is in the order triphosphate > diphosphate > monophosphate. Also, UDP > UDP-glucose > UDP-acetylglucosamine > NAD. Incorporation into the terminal phosphates of the adenosine compound is in the order $P_3-ATP > P_2-ADP > P_1-AMP$. The data indicate that the rate of the myokinase reaction ($ATP + AMP \rightleftharpoons 2ADP$) is slower in the small intestines than in the liver while that of ATP synthesis is the same. (C.O.)

33617 UPTAKE OF ^{47}Ca AND ^{85}Sr IN THE TIBIA AND THE FEMUR IN RATS. Nilsson, Bo E. (Malmo General Hospital, Sweden). Calcified Tissue Res., 3: 96-9(Jan. 31, 1969).

The discrimination of radiostrontium as compared to radiocalcium was studied in different bones, different parts of the bones, and in bones where the metabolic activity was changed because of fracture. Seven weeks after tibial fracture in mature female rats the animals were injected intraperitoneally with a mixture of $^{85}SrNO_3$ and $^{47}CaNO_3$; about 3 μCi of each. The ratio between the uptake of ^{85}Sr and ^{47}Ca was measured in the tibia and femora 24 hr after injection of the isotopes. The $^{85}Sr/^{47}Ca$ in the healed fracture did not differ from the shafts but was significantly greater than in the ends. The ratio in the ends of the bones did not differ between the fractured and the control legs nor between the tibia and femora. Similarly there were no differences between the shafts of the bones. The $^{85}Sr/^{47}Ca$ ratio was significantly greater in the shafts as compared to the ends, in each bone separately and between the bones. These results indicate that there is a constant difference in the degree of discrimination of radiostrontium between trabecular and cortical bone in rats and that this difference is maintained also when the mineral turnover rate in cortical bone is increased because of a fracture. (BBB)

33618 METHODS AND APPLICATIONS OF QUANTITATIVE COMPUTER-ANALYSED SCANNING. Laughlin, J. S.; Kenny, P. J.; Weber, D. A.; Dwyer, A. J.; Mayer, K.; Greenberg, E. J.; Dimich, A. B.; Hasan, S. (Sloan-Kettering Inst. for Cancer Research, New York). Contracts AT(30-1)-910; NCI-CA 08748. pp 633-52 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

A program of metabolic studies was carried out with quantitative procedures during the past decade with a variety of radionuclides and labeled compounds. These studies demonstrated the capabilities of these methods, not only for kinetic studies but also for diagnostic and localization purposes. Display options have regularly included digital scans, computer-analyzed scans, and also photoscans. Seven features of the quantitative scanning method are illustrated with both research and diagnostic examples. (auth)

33619 THE DISTRIBUTION OF COLLOIDAL THORIUM DIOXIDE IN MOUSE LIVER AFTER INTRAVENOUS INJECTION. Hampton, J. C.; Rosario, B. (Northwestern Univ., Chicago). Contract AT(11-1)-1244. Ann. N. Y. Acad. Sci., 145: 533-44 (Dec. 11, 1967). (COO-1244-4).

The distribution in mouse liver of ThO_2 at 10 minutes and 1 month after intravenous and intrasplenic injection was not significantly different for doses of 0.1, 0.25, and 0.5 ml. At 10 minutes after injection, particles were still present extracellularly in sinusoidal lumens, in the space of Disse, and in spaces between hepatic parenchymal cells. Many particles were bound to the plasma membranes of and within the cytoplasm of Kupffer cells. The particles did not appear to be bound to the plasma membrane of parenchymal cells but were taken up by them through vesicle formation both at the cell surface bordering upon that space of Disse and at the surface bordering intercellular spaces. At one month after injection sinusoids were occluded by large Kupffer cells packed with particles. The space of Disse surrounding occluded sinusoids was obliterated and often contained bundles of collagen. Dense aggregates of particles were found in parenchymal cells and occasionally in bile canaliculi. On rare occasions loose aggregates of particles were found in parenchymal cell nuclei. (auth)

Radiation Effects

Refer also to abstracts 33241, 33242, 33667, 33686, 33803, 33809, 33812, 33833, and 33870.

33620 (AD-680611) EARLY INCREASE IN THE MISCIBLE DEOXYCYTIDINE POOL IN RATS AFTER X IRRADIATION. Guri, Charles D.; Minot, Henry J.; Swingle, Karl F. (Naval Radiological Defense Lab., San Francisco, Calif.). Nov. 22, 1968. 20p. (USNRDL-TR-68-138). CFSTI.

Intraperitoneal and intravenous injections of tracer quantities of ^{3}H or ^{14}C labeled deoxycytidine (CdR) were used to investigate the biologic half-life, the miscible pool size, and the turnover rate of CdR in normal and x irradiated rats. The specific activity of highly purified CdR isolated from blood plasma samples taken at various times after injection of the tracer CdR was used as the basis for calculating these values. The mean values observed for normal rats were: biological half-life 116 minutes, miscible pool 790 micro g/rat (100 to 180 g), and turnover rate 7.0 mg/24 hours/rat. The miscible pool of CdR appeared to be non-uniform, with the intracellular concentration appreciably higher than the general body-water concentration. About one-third of the total miscible CdR appeared to be intracellular. After relatively low doses of whole-body x irradiation (25 to 100 rads), there were alterations in the turnover kinetics of CdR, but the presence of non-steady state made computation of the above three values impossible. However, the data are fully consistent with an increase in the miscible pool size of CdR, occurring as early as one hour postirradiation. The data do not provide information as to the mechanism for this apparent increase. (auth) (STAR)

33621 (AD-680624) A LOW-FIELD ELECTRON SPIN RESONANCE STUDY OF THE EFFECT OF RADIATION IN LIVING ANIMALS. Final Report. Whitmore, Frank C.; Bryson, Charles E. (Southwest Research Inst., San Antonio, Tex.). Sept. 1, 1968. Contract DA-49-146-XZ-560. 79p. (DASA-2153). CFSTI.

It was demonstrated that free radicals are formed in living systems as a consequence of exposure of these systems to various kinds of ionizing radiation. In addition, it was shown that it is possible to obtain the environmental conditions necessary to produce ESR while simultaneously maintaining those necessary for the survival of a living test specimen. It was also demonstrated that a conveniently used, highly reproducible electronic system can be developed for the operation and control of an L-band spectrometer. (auth) (STAR)

33622 (AD-681709) EFFECTIVENESS OF DRUGS IN ANIMALS EXPOSED TO MIXED GAMMA-NEUTRON RADIATIONS. V. BARBITURATES. Davis, L. W.; Brown, J. A.; Strike, T. A. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). Sept. 1968. 22p. (AFRII-SR-68-19). CFSTI.

The plasma disappearance half-times of barbital, hexobarbital, and pentobarbital, and the plasma and cerebrospinal fluid disappearance half-times of ^{14}C-labeled pentobarbital were determined in male monkeys (Macaca mulatta). These half-time values were compared to those obtained from monkeys which had received 1500-, 5000-, or 10,000 rad doses of mixed gamma-neutron radiations. A radiation dose-related increase of plasma disappearance half-times for all drugs was evident with a significant increase for barbital after 5000 rads ($P < 0.001$) and hexabarbital after 10,000 rads ($P < 0.05$). Cerebrospinal fluid disappearance half-time of pentobarbital was significantly prolonged in the monkeys receiving 5000 rads. Irradiated monkeys also had prolonged duration of sleep when compared with their preirradiation results. These results are interpreted as indicating that the blood-brain barrier

permeability for some barbituates is altered in irradiated monkeys; radiation causes a greater decrease in renal excretion of barbiturates than in detoxification of barbiturates by liver enzymes; and the increased duration of effectiveness of barbiturates in irradiated monkeys is related to decreased excretion, decreased drug metabolism, and increased drug concentration in the central nervous system. (auth) (USGRDR)

33623 (AD-682923) GASTRIC MUCOSA AFTER IRRADIATION. II. INHIBITION OF GASTRIN-STIMULATED ACID SECRETION (pH 3.0) IN RELATION TO TRANSLOCASE ACTIVITY. Vaughan, Burton E.; Cummins, Joseph T.; Pessotti, Rita L. (Naval Radiological Defense Lab., San Francisco, Calif.). Dec. 20, 1968. 18p. (USNRDL-TR-68-148). CFSTI.

Immediately after a dose of 240 R, whole body x irradiation, spontaneous (non-stimulated) acid secretion was inhibited. The inhibition was transient and acid secretion resumed promptly after injection of gastrin as the semipurified hormone. During the stimulation phase, a subsequent irradiation dose of 3000 R caused inhibition which was also transient, since secretion resumed immediately on cessation of the irradiation. Under standard conditions of gastrin stimulation, a dose dependent reduction in acid secretion could be demonstrated, using dose levels of 600 R and 1200 R, given 4 hours earlier. This dose dependent inhibition could be detected only when acid secretion was maximally stimulated by gastrin. The Skou transport enzyme was isolated, also, from gastric mucosa, under identical conditions of irradiation and gastrin treatment. Activity of transport enzyme, in other studies, was found to be radiation sensitive in this dose range, but its activity under present conditions was remarkably constant and unaffected by gastrin or irradiation treatments. Present findings indicated that irradiation doses of 600 to 1200 R caused negligible functional damage to the acid secretory mechanism, as in parietal cells. However, inhibition of nerve activity, necessary for maintenance of high acid secretion rates, evidently did occur. (auth) (USGRDR)

33624 (AD-843701) PROLONGED AFTERGLOW AQUEOUS SOLUTIONS OF PROTEINS AND SYNTHETIC POLYMERS IRRADIATED WITH X-RAYS. Sapezhinskii, I. I.; Silaev, Yu. V.; Emanuel, N. M. Translated from Dokl. Akad. Nauk SSSR, 159: 1378-80(1964). 8p. (PA-TT-123). CFSTI.

An attempt was made to detect afterglow in aqueous solutions of proteins and synthetic polymers. It was found that irradiation of solutions with doses of 1 to 10 krad at room temperature produces a feeble glow which continues for hundreds of seconds after the irradiation. The experiments were performed in an open-circulation setup. The solution was irradiated with x rays in a thermostat-controlled (t ∓ 25C) vessel and then rapidly pumped to a thermostat-controlled cuvette located in the neighborhood of the photocathode of photomultiplier. The photocurrent was amplified and the kinetic curves of afterglow were recorded on an electronic potentiometer. (auth) (TAB)

33625 (AD-843709) NATURE OF THE EXTREMELY FEEBLE GLOW OF IRRADIATED SOLUTIONS OF DEOXYRIBONUCLEIC ACID (DNA). Zhizhina, G. P.; Kruglyskeva, K. E.; Emanuel, N. M. Translated from Dokl. Akad. Nauk SSSR, 163: 931-4(1965). 10p. (PA-TT-124). CFSTI.

Evidence is presented that the glow of irradiated DNA solutions represents a chemiluminescence of a free-radical nature that is conditioned by the presence of hydroperoxide DNA compounds in the system. (TAB)

33626 (ORO-3546-7) INFLUENCE OF THE PHYSICAL STATE OF CHROMATIN ON NUCLEIC ACID AND PROTEIN SYNTHESIS AND ON RADIATION SENSITIVITY OF CELL DIVISION. Progress Report, September 1, 1968-August 31, 1969. Gaulden, Mary Esther (Texas Univ., Dallas. Southwestern Medical School). May 30, 1969. Contract AT(40-1)-3546. 7p. Dep. CFSTI.

The induction of pseudo-diapause (temporary complete cessation of development) in grasshopper (Chortophaga viridifasciata) embryos was accomplished by placing the embryos at 11°C. No detrimental effects were observed for storage periods up to six months and hatchability was actually higher in the eggs stored at 11°C than in the controls. Attempts to culture individual neuroblasts on Shaw's, Eagle's, or Grace's culture medium revealed that Eagle's medium was superior to the others in maintaining the cells in normal condition and fostering cell division. The effects of the degree of condensation of chromatin on its ability to synthesize DNA, RNA, and protein were studied in cultured grasshopper neuroblasts by altering the ionic strength of the culture medium. Data indicated that condensation of the chromosomes before or just after initiation of RNA synthesis prevented or greatly reduced synthesis, but synthesis was reduced only slightly (5 to 15%) when the chromatin was condensed after the cell was well into the process. The pattern of protein labeling at all phases of the cell cycle was studied in neuroblasts using tritium-labeled amino acids. Uptake of the labeled amino acids was observed at all stages from early telophase through late prophase, but not during midmitotic periods. Investigations on the effects of x radiation on uptake of tritium-labeled thymidine in late prophase and metaphase showed no uptake in metaphase, and uptake only in those prophase cells that were delayed, showed prophase reversion. The results suggested that the degree of chromosome condensation was a determining factor in the uptake of tritium-labeled thymidine. Studies on the effects of colchicine on the mitotic rate of neuroblasts revealed that at concentrations of 25×10^{-4}M, cells in middle prophase underwent reversion to earlier stages. Telophase and interphase cells were also greatly retarded. It was also concluded that telophase, middle prophase, and the first part of late prophase were the most sensitive phases of the cell cycle to x rays. (E.R.B.)

33627 RADIOSENSITIVITY OF MAMMALIAN CELLS. II. RADIATION EFFECTS ON MACROMOLECULAR SYNTHESIS. Walters, R. A.; Petersen, D. F. (Los Alamos Scientific Lab., N. Mex.). Biophys. J., 8: 1487-1504(1968). (LA-DC-9198).

Radiation effects on macromolecular synthesis essential for the Chinese hamster cell to traverse the life cycle and to divide have been investigated. Life-cycle analysis techniques employing inhibitors of macromolecular synthesis were used in determining the kinetics of cell growth for specific segments of the population following spontaneous recovery from radiation-induced division delay. The results indicated that recovery does not occur in the absence of functional protein synthesis. Under conditions which inhibit normal RNA and DNA synthesis, irradiated cells can recover the capacity to traverse the life cycle and to divide. The stability of mRNA species coding for proteins essential for division in irradiated cells was also measured. The mean functional lifetime of these mRNA species was 1 hr. The data demonstrate the existence of a specific segment of the population consisting of cells which have completed transcription related to division but not concomitant translation and which can recover from the radiation injury without synthesis of additional RNA. Thus, initial recovery of the ability to divide has an obligate requirement for protein synthesis but no corresponding requirement for nucleic acid synthesis during the period when original messenger remains intact. (auth)

33628 DNA STRAND BREAKAGE IN CELLS IRRADIATED WITH X-RAYS. Dean, C. J.; Ormerod, M. G.; Serianni, R. W.; Alexander, P. (Chester Beatty Research Inst., Sutton, Eng.). Nature (London), 222: 1042-4(June 14, 1969).

The presence of oxygen during the exposure of mammalian and bacterial cells to x rays does not affect the efficiency of single strand breakage of DNA, but in bacteria it interferes with strand rejoining processes which occur during irradiation. (auth) (UK)

33629 RNA SYNTHESIS IN ESCHERICHIA COLI AFTER IRRADIATION WITH ULTRAVIOLET LIGHT. Michalke, Hildegard; Bremer, Hans (Southwest Center for Advanced Studies, Dallas). J. Mol. Biol., 41: 1-23(Apr. 14, 1969).

Escherichia coli B and derivatives with different sensitivity to ultraviolet light ($B/r, B, B_{s-1}$) were irradiated with uv doses ranging from 500 to 10,000 erg/mm^2. Post-irradiation RNA synthesis was measured, and the sedimentation distributions of RNA synthesized after irradiation were determined. The following conclusions were drawn. Synthesis of RNA molecules is terminated and RNA polymerase molecules are liberated at the site of uv lesions on the DNA. A dose of 1000 erg/mm^2 produces about one transcription-terminating lesion per 1000 DNA base pairs in all of the bacterial strains used. This number is approximately equal to one-half of the number of pyrimidine dimers reportedly produced by that dose, suggesting that every pyrimidine dimer located on the functional DNA strand stops transcription. Within 45 minutes after irradiation (dose greater than 1000 erg/mm^2) the RNA synthesis rate in the bacterial strains tested is not significantly increased by photo- or dark repair under the conditions used. With increasing uv dose, the rate of RNA chain initiation (number of molecules produced per unit time) is reduced. This reduction may be caused by irreversible binding or delayed liberation of RNA polymerase molecules at uv lesions. Most fragments and some complete molecules of ribosomal RNA synthesized after uv irradiation are broken down within 45 minutes after synthesis. (auth)

33630 ALTERATIONS IN THE RESORPTION OF DRUGS IN IRRADIATED ORGANISMS. Grossmann, Vojtech (Charles Univ., Hradec Kralove, Czech.). Therapie, 22: 1421-8(Nov.-Dec. 1967). (In French).

Effects of barium sulfate and sulfur-35-labeled sodium sulfate on irradiated rats were studied following oral administration.

Retention of stomach contents increased during the first three or four days, and absorption of the drugs resulted in abnormal intestinal motility. (auth)

33631 ULTRAVIOLET LIGHT ALTERATION OF CELLULAR DEOXYRIBONUCLEIC ACID IN VIVO. Tan, Eng M.; Stoughton, Richard B. (Scripps Clinic and Research Foundation, La Jolla, Calif.). Proc. Nat. Acad. Sci. U. S., 62: 708-14 (Mar. 1969).

Deoxyribonucleic acid irradiated with uv radiation was immunogenic in rabbits and elicited serum antibodies reacting specifically with uv-irradiated DNA. The serological reactions were demonstrated by immunodiffusion, complement fixation, and immunofluorescence. By immunofluorescence, antisera reacted with cell nuclei of irradiated mouse tissue sections but not with unirradiated tissue. This method was employed to show the presence of uv lesions in tissues of mice exposed to uv light. Lesions in uv-irradiated DNA were present in nuclei of epidermal cells, and in heavily irradiated animals; they were also detected in the corium immediately below the epidermis. The method is useful not only for directly demonstrating uv lesions of DNA but also for localizing such lesions in tissues. (auth)

33632 PROTEIN SYNTHESIS IN ESCHERICHIA COLI AFTER IRRADIATION WITH ULTRAVIOLET LIGHT. Brunschede, Horst; Bremer, Hans (Southwest Center for Advanced Studies, Dallas). J. Mol. Biol., 41: 25-38(Apr. 14, 1969).

Post-irradiation protein and RNA synthesis were studied in Escherichia coli cells exposed to ultraviolet light doses ranging from 250 to 5000 erg/mm^2. The following conclusions were drawn. In uv-irradiated cells abnormal, shortened polypeptide chains are synthesized in addition to normal ones, presumably on shortened messenger RNA molecules which are reportedly produced when transcription is prematurely terminated at the site of uv lesions in DNA. In uv-irradiated cells the number of polypeptide chains synthesized per unit time is also reduced, which is attributed to a reduced rate of messenger RNA synthesis. The release of nascent proteins from polysomes is not greatly delayed in uv-irradiated cells, indicating that the termination of protein synthesis at the 3'-end of the messenger RNA molecule does not necessarily require a special termination sequence. After uv irradiation, polysomes contain defective ribosomal subunits. (auth)

33633 INCREASE OF LIPID PEROXIDES OF TISSUES IN IRRADIATION UNDER LOCAL PROTECTION. Furnica, Maria; Danicel, M. (Institutul Oncologic, Bucharest). Fiziol. Norm. Patol. (Bucharest), 14: 173-8(Mar.-Apr. 1968). (In Rumanian).

Rats, with protected head and abdomen, were irradiated with 1,000 R, and sacrificed after 3 days for determination of the lipid peroxides in the brain, liver, spleen and intestinal mucosa. The results were compared with those obtained in irradiated, unprotected animals. Irradiation produced an important increase in the peroxides of the different tissues studied. Protection of the head at the moment of irradiation attenuates these effects very much. The protective effect on the abdomen was less marked as regards the formation of peroxides. The results obtained lend support to the notion of the implication of peroxides in the irradiation disease. Stress is laid on the role of local and general factors in determination of the degree of peroxidation. (auth)

33634 THE COURSE AND IMPORTANCE OF THE CHANGES IN THE MAJOR MINERAL COMPONENTS IN RADIATION SICKNESS AND THEIR RELATIONSHIP TO SOME METABOLIC AND CIRCULATORY PARAMETERS. Kos. J.; Vycichl, J.; Tichy, M. (Purkyne Military Medical Research and Postgraduate Training Inst., Hradec Kralove, Czech.). Cas. Lek. Cesk., 108: 412-16(Mar. 28, 1969). (In Czech).

Severe depletion of muscle potassium and a drop in muscle proteins resulting from a gastrointestinal syndrome develops after whole-body irradiation in dogs. Sodium and water levels increased, but these changes were not proportional to the extent of the irradiation. No significant changes were observed in the heart muscle of severely sick dogs. The potassium gradient increased but EEG signs of K deficiency were not observed. (JPRS)

33635 EFFECTS OF LOW IRRADIATION DOSES ON THE ULTRASTRUCTURE OF THE RAT MYOCARDIUM. Novi, A. M. (Univ., Pisa). Virchows Arch., B, 2: 24-31(1969).

Ultramicroscopic observations were made of the effects of low radiation doses on myocardial tissue, and a comparison was made of the degree of damage between heart muscle cells and coronary vessels for evidence of direct damage to the cardiac muscle cells. The animals were exposed to ^{60}Co for a single dose of 500 R to a midpoint of the left ventricle. No behavioral changes or loss of weight were observed in rats killed at 12 and 24 hr, 10, 30, 60, and 120 days after irradiation. At 12 hr after irradiation numerous mitochondria in cardiac cells were markedly swollen, their cristae separated from each other; other cell components were unaffected. The capillary walls showed no morphologic changes. At 24 hr after irradiation most myocardial cells showed mitochondrial lesions, and alterations of contractile material were frequently found in restricted cytoplasmic areas adjacent to the highly swollen mitochondria. At ten days after irradiation only a few myocardial cells showed mitochondrial lesions and no morphological modifications of contractile material could be detected. The capillary walls showed normal features after transient vacuolization of endothelial cells. No morphologic changes were seen at 30, 60, and 120 days after irradiation. (BBB) (TSS)

33636 A STUDY OF 'HEMOSIDERIN' IN THE MARROW OF THE FEMUR OF NORMAL YOUNG ADULT RABBITS COMPARED WITH THAT IN RABBITS 4 MONTHS AFTER AN INTRAVENOUS INJECTION OF $^{239}Pu(NO_3)_4$. Beno, Milan (Inst. of Industrial Hygiene, Bratislava). Brit. J. Haematol., 15: 487-93(Nov. 1968).

The number of cells containing storage Fe in normal rabbit marrow and whether this number is affected by the presence of ^{239}Pu were studied. Seven-month-old Dutch rabbits of both sexes fed on a standard diet, received 1.15 μCi/kg of $^{239}Pu(NO_3)_4$ by intravenous injection and were killed 16 weeks later. The distribution of cells containing Fe, as demonstrated by Perls' reagent, was examined in the marrow of the femur. The number of Fe-containing cells, probably macrophages, was found to be variable in the length of the bone and also from one normal rabbit to another. The amount of pigment in any one cell was also variable. A significant increase in Fe-containing cells and in the amount of pigment the cells contained was noted in the marrow of the femur of rabbits 4 months after injection of ^{239}Pu, compared with the normal controls. The ^{239}Pu aggregates close to the mineralized surface were not usually associated with hemosiderin. Possible reasons why ^{239}Pu is retained in macrophages and why the number of such cells and the amount of hemosiderin they contain is increased following ^{239}Pu injection are discussed. The only clue at present is the observation that ^{239}Pu causes some degree of anemia. Increased red cell destruction may account for increase in storage Fe though no fall in hemoglobin was noted. (BBB)

33637 ULTRAVIOLET LIGHT INDUCED FREE RADICALS IN GLYCINE PEPTIDES IN THE SOLID STATE. Collins, M. A.; Grant, R. A. (Dept. of Scientific and Industrial Research, Lower Hutt, New Zealand). Photochem. Photobiol., 9: 369-75(Apr. 1969).

The effect of uv radiation on glycine, diglycine, triglycine, and polyglycine in the solid state was investigated using electron spin resonance. The irradiated diglycine and triglycine displayed signals commonly encountered when more energetic radiations are employed, but polyglycine displayed an additional signal not previously described and the signal from glycine was found to differ from those produced by other radiations. (auth)

33638 THE EFFECT OF X-IRRADIATION ON THE ACTIVITY OF NICOTINAMIDE DEAMIDASE IN RAT LIVER. Zicha, Blahoslav; Buric, Lubomir; Benes, Jiri (Charles Univ., Prague). Strahlentherapie, 137: 183-6(Feb. 1969).

The dependence of the activity of nicotinamide deamidase of rat liver upon the time interval after irradiation of rats by a dose of 1400 R was studied. An increase of enzyme activity of about 300% occurred in the time interval of 5 hrs after irradiation. After single administration of nicotinamide the activity of the enzyme was also increased at the same level. On the contrary the triple increase was not observed after simultaneous irradiation and nicotinamide loading. (tr-auth)

33639 ULTRAVIOLET LIGHT INDUCED DAMAGE TO DESOXYRIBONUCLEIC ACID IN HUMAN SKIN. Tan, Eng M.; Stoughton, Richard B. (Scripps Clinic and Research Foundation, La Jolla, Calif.). Contract DA 17-67-C-7159. J. Invest. Dermatol., 52: 537-42(June 1969).

Exposure of human skin to ultraviolet light in vivo results in immediate changes in desoxyribonucleic acid in the nuclei of the epidermal cells. These in vivo changes are demonstrated by immunofluorescence using antibodies specific for desoxyribonucleic acid altered by exposure to ultraviolet light. (auth)

33640 MOLECULAR EXCITATIONS IN RADIATION DAMAGE AS STUDIED BY THE RADIATION-INDUCED LUMINESCENCE OF PROTEINS. Steen, H. B. (Norsk Hydro's Inst. for Cancer Research, Montebello, Norway). Scand. J. Clin. Lab. Invest., 22: Suppl. 106, 21-30(1968).

Radiation-induced luminescence of tryptophan, tyrosine, and trypsin was studied with the intention of elucidating the possible

importance of molecular excitations for the radiation damage of proteins. In all these substances the spectrum of the x-ray induced emission, as obtained at 77°K, was similar to that excited by uv light, except that a considerable enhancement of the phosphorescence to fluorescence ratio occurred with x irradiation. This could be accounted for by assuming that about 90% of the emission resulted from electron-ion recombination, subsequently giving rise to excitation of the radiative levels. The G value for the emission of light was 5 for both tryptophan and tyrosine, leading to the conclusion that at least 40% of the total number of ionizations resulted in recombination and subsequent emission of light. The emission from trypsin appeared to originate almost exclusively from the tryptophan residues. The emission yield (G = 0.17) indicated that energy transfer did not contribute significantly to the emission of this protein. A possible relation between the temperature dependence of the luminescence of trypsin and that of its radiation sensitivity is discussed. (BBB)

33641 RIBOSOME DEGRADATION IN ULTRAVIOLET LIGHT-DAMAGED BACTERIA STARVED FOR AN AMINO ACID. Doudney, C. O. (Albert Einstein Medical Center, Philadelphia, Pa.). Biochim. Biophys. Acta, 179: 106-14(Mar. 18, 1969).

The effect of uv exposure on the stability of ribosomes and RNA in bacteria starved for a required amino acid was studied. Escherichia coli strains H/r 30 and H/r 30R were used in these studies. These strains require arginine. Strain H/r 30 is a radiation-resistant strain lacking the enzymatic capacity for photoreversibility. Strain H/r 30R is a revertant of H/r 30 which has regained capacity for photoreversibility. They were exposed to uv light from a General Electric germicidal lamp (15 W). The dose below 2800 Å was 50 sec at the average rate of 8 erg/mm²/sec. This dose decreased survival (colony formation) to 23% of the bacteria and resulted in a delay in initiation of net DNA synthesis of 40 min. Degradation of RNA and of 30 S and 50 S ribosomes occurred when H/r 30R cells were exposed to 400 erg/mm² of uv light and then incubated without arginine, the required amino acid. Under these conditions, the ribosomes remained stable for 1 hr, but rapid breakdown began thereafter and eliminated the greater part of the ribosomes by 2 hr. Arginine prevented most of the breakdown. Both of the photoreversible pyrimidine dimer and nonphotoreversible damage resulted in breakdown, but at this uv dose most of the damage was not photoreversible. If 30 min of postirradiation incubation with arginine was allowed prior to incubation without the amino acid, little degradation occurred on subsequent argininеless incubation, indicating that dark repair processes dependent on protein synthesis are capable of removing the cause of the breakdown, presumably through repair of damage to DNA resulting in recovery of capacity for DNA replication. (BBB)

33642 GLYCOGEN DISTRIBUTION IN THE RETINA OF THE GUINEA PIG AFTER X IRRADIATION. Bolte, H.; Lierse, Werner; Franke, H. D. (Univ., Hamburg). Z. Mikrosk.-Anat. Forsch., 79: 82-92(1968). (In German).

Adult guinea pigs were x irradiated with doses of 100 to 3000 R at the level of the midbrain. At a dose level of 1000 R, necrobioses of the ganglion cells of the optic fasciculus were observed. At doses greater than 1000 R, necroses of the ganglion cell nuclei were observed. These appeared to result directly from the irradiation or because of enzyme damage. Early changes observed included increased glycogen deposition in the internal regions of the retina, and decreased glycogen deposition in the external layers after a dose of 250 R. Glycogen concentration was maximal within the internal portions of the retina after a dose of 1000 R, but decreased after doses of 2000 or 3000 R. After a dose of 250 R, glycogen-containing vacuoles were observed in the terminal portions of the supporting Mueller fibers within the internal limiting membrane. Vacuoles were observed in the 3 most internal layers of the retina after a dose of 2000 R. (BBB)

33643 STUDIES OF THE NUCLEIC ACID METABOLISM OF MONKEY KIDNEY TISSUE CULTURE CELLS AFTER INFECTION WITH SV_{40}. IV. EFFECT OF ANTIMETABOLITES AND X RAYS ON THE FORMATION OF ENZYMES OF NUCLEIC ACID METABOLISM. Haas, R.; Wuppermann, G.; Werchau, H.; Maass, G.; Schuchmann, L.; Kroeger, H. Arch. Gesam. Virusforsch., 22: 305-15(Jan. 1968). (In German).

The activities of thymidine kinase and deoxyribonucleic polymerase were about 30% greater in nonirradiated primary cultures of green monkey (Cercopithecus aethiops) kidney cells not infected with SV-40 virus than in x-irradiated cultures. After x irradiation of cultures infected with SV-40 there was increased activity of these enzymes that was similar in amount to increases observed in infected cultures that were not irradiated, provided that the x irradiation took place before infection. (BBB)

33644 ABSORPTION OF IRON FOLLOWING X-IRRADIATION OF THE EXTERIORIZED SMALL INTESTINE. Donati, R. M.; Berman, A. R.; Jervis, H. R.; Stromberg, LW. R.; Sprinz, H. (Walter Reed Army Inst. of Research, Washington, D. C.). Proc. Soc. Exp. Biol. Med., 130: 822-7(Mar. 1969).

The intestinal absorption of ^{56}Fe and ^{59}Fe was determined following x irradiation of the exteriorized small intestine in the rat. The morphologic lesion resulting was discontinuous, with areas of intestinal radiation injury alternating with areas which were essentially intact or hypertrophic. The results indicate that there was an increase in radioiron absorption following irradiation and suggest that this increase was caused by augmented absorption in those areas of the small intestine which did not develop the morphologic characteristics of severe radiation injury. Possible mechanisms are discussed. (auth)

33645 PROTEIN CATABOLISM IN YOUNG MICE FOLLOWING WHOLE-BODY X IRRADIATION. Lippincott, S. W.; Azzam, N. A.; Rogers, C. C. (Medical Coll. of Virginia, Richmond). Radiology, 92: 629-30(Mar. 1969).

The rate of metabolic turnover of human ^{131}I-albumin expressed as biological half-life was determined in two untreated groups of 3-month-old male C3H mice totalling 27, and in three groups totalling 25 which received whole-body x irradiation of 300, 600, and 900 rads respectively. The metabolic study in the last three groups was initiated between 85 and 90 hours postirradiation because weight curves, as one expression of postirradiation injury, suggested that by this time substantial recovery had occurred, although continuing injury might well be present. All mice were injected intraperitoneally with ^{131}I-albumin, and retention of the labeled protein was determined at 24-, 48-, and 72-hour intervals from whole-body counting. The protein catabolism rate was significantly increased with radiation dose. (C.H.)

33646 STUDY OF THE INACTIVATION BY IONIZING RADIATIONS OF THE ACCEPTOR PROPERTIES OF TRANSFER RIBONUCLEIC ACID. Ekert, B.; Monier, R.; Tordjman, A. (Radium-Fondation Curie, Paris). Bull. Soc. Chim. Biol., 50: 1875-86 (1968). (In French).

The effect of ^{60}Co γ irradiation in doses of 50, 100, and 150 Krad on the amino acid acceptor function of yeast transfer RNA (t-RNA) and on other physical and chemical properties of t-RNA was studied. The acceptor action of t-RNA toward valine and tyrosine irradiated in 0.033M Na_2SO_4 at a concentration of 200 μg/ml was inactivated as an exponential function of radiation dose. The valine t-RNA was more sensitive than tyrosine t-RNA to irradiation. Tyrosine t-RNA was equally sensitive in the presence and absence of oxygen, whereas valine t-RNA was more radiosensitive in the absence of oxygen. Rupture of phosphodiester bonds in t-RNA by irradiation was demonstrated, the extent being proportional to dose between 0 and 150 Krad. The G value for this reaction was 0.16 in the presence and 0.22 in the absence of oxygen; that is, 22,850 and 16,500 rad, respectively, were required to rupture one phosphodiester bond. Chromatographic analysis of irradiated t-RNA was carried out. A sharp increase of absorption at 260 mμ was seen in t-RNA irradiated with doses up to 40 Krad; thereafter, absorption decreased. Increase of temperature between 30 and 70°C increased the hyperchromic effect of irradiation, at 260 mμ. No influence of oxygen on the radioinduced hyperchromic effect could be found. It was concluded that inactivation of t-RNA results from rupture of phosphodiester bonds. (BBB)

33647 RADIATION INJURY OF THE CELL AS SEEN ELECTRON MICROSCOPICALLY. Morgenroth, Konrad Jr. (Univ., Muenster, Ger.). Deut. Zahnaerztl. Z., 22: 153-8(Feb. 1967). (In German).

Ultrastructural changes were examined in liver, kidney, spleen, and heart muscle of mice, rats, and guinea pigs exposed to whole-body or local doses of 300 to 9000 R of 50- and 200-kV x rays, ^{60}Co γ rays, or colloidal radiogold. Mitochondria showed the most pronounced changes, responding by swelling soon after irradiation, then by shortening of the cristae. The cristae showed vacuolar and granular changes. Other membranous structures, including endoplasmic reticulum and Golgi apparatus, underwent swelling also. It was established that the damage takes a relatively uniform course in all the organs examined. In ultrastructures the morphology of the radiation damage did not show any striking relation to the quality of radiation. With the electron microscope the onset of the damage could be visualized. It was shown that even in cells of types known to be resistant to radiation considerable changes occurred in the cellular structure relatively soon after irradiation. (BBB)

33648 EARLY CHANGES OF OXYGEN BALANCE IN THE ORGANISM OF ALBINO RATS IRRADIATED WITH FAST NEUTRONS. Druzhina, M. A. Fiziol. Zh., Akad. Nauk Ukr. RSR, 14: 403-4(May-June 1968). (In Ukrainian).

Studies of oxygen balance in rats irradiated with 215 R of fast neutrons revealed significant early changes in the oxygen content in marrow tissue and only negligible changes in the gas exchange and content of hemoglobin in the blood. (R.V.J.)

33649 THE EFFECT OF DOSE-RATE AND ANOXIA ON THE RADIATION-INDUCED LOSS OF MACROMOLECULES INTO THE INTESTINE. Hornsey, Shirley; Hedges, M. J. (Hammersmith Hospital, London). Brit. J. Radiol., 42: 278-80(Apr. 1969).

The leakage into the gut in mice of molecules of ^{131}I polyvinylpyrrolidone (P.V.P.) of the size of plasma protein molecules, has been measured after whole-body irradiation of animals while breathing oxygen or nitrogen. Irradiation was carried out using 8 MeV electrons and 250 kVp x rays. Results suggest that the protective effect of anoxia may be higher for this test of damage than for the acute intestinal syndrome, i.e., death at four to five days. The effect of changes in dose-rate seen for the four-to-five day death endpoint is not reflected in the measurements of leakage of ^{131}I P.V.P. (auth)

Immunology

Refer also to abstract 33846.

33650 RETARDED IMMUNOLOGICAL RECOVERY IN SUBLETHALLY X-IRRADIATED MICE BY ADDITIONAL THYMIC EXPOSURE. REVERSAL WITH INJECTED MARROW CELLS. Davis, William E. Jr.; Cole, Leonard J. (Naval Radiological Defence Lab., San Francisco). Proc. Soc. Exp. Biol. Med., 130: 1336-44(Apr. 1969).

Recovery of the immune capacity was investigated in relation to recovery of thymic function and recovery of the immunologic stem cells of the marrow. The effects of these two parameters was studied by re-exposing the thymus of sublethally whole-body x-irradiated mice to high doses of radiation in order to further delay thymic recovery, and by augmenting the pool of marrow cells in other similarly treated animals. The immunological capability of the mice was then measured at various time intervals. The results show that the residual reticular-epithelial cells of the thymus in sublethally irradiated mice are functionally radiosensitive; and that both the recovery of this thymic function and the supply of marrow-derived immunogenic precursor cells are important determinants of the recovery of immunocompetence in sublethally irradiated mice. (H.L.W.)

33651 CELLS INVOLVED IN THE IMMUNE RESPONSE. VII. THE DEMONSTRATION, USING ALLOTYPIC MARKERS, OR ANTIBODY FORMATION BY IRRADIATION-RESISTANT CELLS OF IRRADIATED RABBITS INJECTED WITH NORMAL ALLOGENEIC BONE MARROW CELLS AND SHEEP ERYTHROCYTES. Richter, M.; Abdou, N. I. (Royal Victoria Hospital, Montreal). J. Exp. Med., 129: 1261-73(June 1, 1969).

Bone marrow cells obtained from rabbits of one allotype were injected into irradiated rabbits of a different allotype. The recipients were also injected with sheep red blood cells, and their spleen cells were tested for plaque-forming capacity 7 days later. Spleen cells of all recipients gave large numbers of plaques as did spleen cells incubated with antiserum directed toward donor allotype. However, incubation of the recipient spleen cells with antiserum directed toward recipient allotype suppressed plaque formation. These results demonstrate that antibody-formation in irradiated recipients of transferred lymphoid cells is a property of the recipient animal and that the antibody-forming cell is relatively irradiation-resistant. It was also demonstrated that only viable normal bone marrow cells are capable of transferring antibody-forming capacity to irradiated recipient rabbits. Neither sonicates nor heat-killed preparations of normal rabbit bone marrow cells possessed this capacity. (auth)

33652 ANTIBODY AND IMMUNOGLOBULIN PRODUCTION AT THE CELLULAR LEVEL IN BURSECTOMIZED-IRRADIATED CHICKENS. Alm, Gunnar V.; Peterson, Raymond D. A. (Variety Club Research Center of the La Rabida, Chicago. Univ. of Chicago). J. Exp. Med., 129: 1247-59(June 1, 1969).

The effect of bursectomy combined with sublethal x irradiation in the newly hatched chicken on the immunoglobulin and antibody producing capacity in later life was investigated. The previous findings of a significant incidence of hypogammaglobulinemia in such animals were confirmed. Spleen cells from severely hypogammaglobulinemic animals synthesized and secreted little or no immunoglobulin. Such spleen lymphoid cells contained fewer immunoglobulin antigenic determinants than spleen cells from irradiated control animals as evidenced by their relative inability to respond by an increased DNA synthesis after in vitro culture with rabbit antiserum to chicken immunoglobulin. Therefore, the deficiency in the immunoglobulin synthesis extends not only to actively secreting cells such as plasma cells, but to the entire lymphoid cell population. As expected, most irradiated-bursectomized chickens, irrespective of plasma immunoglobulin levels failed to produce detectable amount of circulating antibodies to Brucella abortus antigen in the primary immune response. Severely hypogammaglobulinemic animals were completely unable to elaborate any plaque forming cells (PFC) in the primary response to sheep red blood cells (SRBC). The results of this investigation support the contention that in the severely hypogammaglobulinemic bursectomized-irradiated chicken the entire antibody producing and immunoglobulin producing cell line is absent. The possibility remains that precursor or stem cells are present but are not appropriately directed to antibody synthesis by other cell types. (auth)

33653 INSULIN-SEPHAROSE: IMMUNOREACTIVITY AND USE IN THE PURIFICATION OF ANTIBODY. Cuatrecasas, Pedro (National Inst. of Health, Bethesda, Md.). Biochem. Biophys. Res. Commun., 35: 531-7(May 22, 1969).

The immunoreactivity of Sepharose and its use in the purification of antibodies were studied. Specifically, the biological effectiveness of insulin-Sepharose derivatives was compared with its ability to bind insulin antibody. Using tritium-labeled antibody-bound insulin, radioimmunoassays showed that the insulin-Sepharose derivatives displaced labeled insulin from its antibody in a manner identical to the displacement caused by native insulin. Of the three derivatives; insulin-lys-Sepharose, insulin-phe-Sepharose, and acetylinsulin-lys-Sepharose, the third one was most immunoreactive, followed by the first and second derivatives in order of decreasing immunoreactivity. The biological effectiveness of the three derivatives as measured in the isolated fat cell system showed the lysine-linked derivative to be the most active, and the acetylinsulin-lys derivative the least active. Columns containing insulin-Sepharose were used to determine the value of the derivatives for use as immunoabsorbents. The lack of nonspecific adsorption of proteins to the unchanged Sepharose polymers, its high binding capacity, the high yield in elution, its stability in storage, good flow properties, suitability for repeated use, and its ease of preparation all characterize insulin-Sepharose as a useful immunoabsorbent. (E.R.B.)

33654 TRANSPLANTATION OF ALLOGENEIC CANINE BONE MARROW STORED AT -80 C. IN DIMETHYL SULFOXIDE. Storb, R.; Epstein, R. B.; Le Blond, R. F.; Rudolph, R. H.; Thomas, E. D. (Univ. of Washington, Seattle. Public Health Service Hospital, Seattle). Blood, 33: 918-23(June 1969).

Prompt initial bone marrow engraftment was observed in 10 lethally irradiated dogs receiving infusions of 9.8 to 30.0 $\times 10^8$ allogeneic marrow cells stored at –80 C. in dimethyl sulfoxide. The three recipients of bone marrow from unrelated donors, mismatched by canine histocompatibility testing, subsequently rejected their grafts and died within 16 days with marrow hypoplasia. The three dogs with matched unrelated donors and the four with matched litter mate donors all showed sustained marrow engraftment. Evidence of marrow repopulation by allogeneic cells was obtained by cytogenetic studies in one and by change to donor red cell type in three instances. (auth)

33655 CANINE LYMPHOSARCOMA MAINTAINED IN SERIAL PASSAGE. Moldovanu, Graziella; Moore, Alice E.; Friedman, M.; Miller, D. G. (Sloan-Kettering Inst. for Cancer Research, New York). Bibl. Haematol., No. 30, 276-8(1968).

From 3rd International Symposium on Comparative Leukemia Research, Paris, France. See CONF-670732.

A dog lymphosarcoma was transplanted for 6 serial passages in x-irradiated pups. The mongrel recipients were x-irradiated less than 2 hr post-partum with 88 R whole-body irradiation. The tumor would not grow in non-irradiated pups even when immunosuppressive drugs were administered. It was not possible to produce the tumor by cell filtrates. The pattern of tumor growth is described. (C.O.)

33656 USE OF THYMECTOMIZED, IRRADIATED RATS TO STUDY IMMUNOGENICITY OF BOVINE γ GLOBULIN. Williams, R. Michael; Waksman, Byron H. (Yale Univ., New Haven). J. Immunol., 102: 925-31(Apr. 1969).

Adult Lewis rats, thymectomized, x-irradiated, and restored with syngeneic bone marrow, developed immunologic memory when 4 to 6 $\times 10^8$ normal Lewis lymph node cells were injected before or up to 5 days after footpad injection of 1.0 mg of crude BGG in saline. Increasing the time interval from 10 to 30 days between x irradiation plus bone marrow repopulation and the injection of lymph node cells plus primary antigen resulted in increased priming. Injection of lymph node cells up to 40 days before primary immunization had little effect on memory pro-

duction. No priming could be demonstrated when lymph node cells were given 10 or more days after primary antigen. (auth)

33657 DIFFERENTIATION OF ANTIBODY-FORMING CELLS. II. EFFECT OF ANTIGEN DOSE ON PROLIFERATION OF PRECURSOR CELLS AND PLAQUE-FORMING CELLS. Campbell, Priscilla A.; Kind, Phyllis (Univ. of Colorado, Denver). J. Immunol., 102: 1084-92(Apr. 1969).

Experiments were conducted to examine the relative roles of proliferation and differentiation of both precursor cells and plaque-forming cells in causing the increase in plaque-forming cells that is seen with higher doses of antigen. Both plaque-forming cells and precursor cells in the spleens of mice were analyzed on days two through seven after injection of 10^6, 10^7, or 10^8 SRBC. Both cell types increased after injection of antigen and reached higher levels with higher doses of antigen. As the dose of antigen was increased, the doubling times of both plaque-forming cells and precursor cells decreased. At every dose of antigen the doubling time of plaque-forming cells was approximately one-half that of precursor cells. (auth)

33658 RECOGNITION OF THE IRRADIATED ISOGENIC MOUSE LYMPHOMA CELL. Maruyama, Yosh (Univ. of Minnesota, Minneapolis). Radiology, 92: 630-2(Mar. 1969).

Results of experiments on x-irradiated isogenic mouse lymphoma cells indicated that irradiation produced changes in the tumor cells which improved the ability of the recipients to recognize them. Radiation-induced division delay or growth alteration in the surviving cells may permit additional time for the host to mobilize its immune defenses against the tumor. The nonirradiated tumor on the left hand would suffer no such disadvantages. Or it may be that tumor cells possess tumor-specific antigens that are not completely exposed. Irradiation may produce sublethal cell injury and cell-surface unfolding, thereby exposing the antigenic sites or alter the permeability or antigenicity of the cell. No residual heterozygosity was detectable in the strain by transfers of skin, bone marrow, or spleen cells between animals of the same sex. The features of syngenic recognition are discussed. It was concluded that resistance against treated cells may be increased by radiation exposure. (C.H.)

33659 STUDIES ON TRANSPLANTATION IMMUNITY OF METHYLCHOLANTHRENE-INDUCED TUMOR IN MICE. Kitano, Morihisa (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 47: 27-48(Jan. 1969).

For the purpose of investigating whether transplanted tumor grafts in mice immunized by the same tumor are destroyed by cellular antibodies, by humoral antibodies, or by both, sarcomas induced by methyl cholanthrene (MC) were implanted intraperitoneally in isologous mice sensitized with MC-sarcoma irradiated with ^{60}Co. The single diffusion chamber method in mice sensitized by the same tumor showed a remarkable immune resistance to target tumors in both cell-permeable and cell-impermeable diffusion chambers, whereas no resistance was observed in mice sensitized by normal tissue. The double diffusion chamber method with cell-permeable Millipore Filter (MF) used as the septal membrane, showed again that injury of the target tumor seemed to be due to contact with sensitized lymphocytes, but when cell-impermeable MF was used as the septal membrane target cell injury occurred even without direct contact with sensitized lymphocytes. Therefore, it can be concluded that when lymphocytes can pass through the membrane of the diffusion chamber, target tumor cells are destroyed by contact with sensitized lymphocytes, but when they cannot pass through the membrane, sensitized lymphocytes go as close as possible to the target cells, and a humoral substance from the lymphocytes plays a large role in the immune response. (auth)

33660 BONE MARROW TREATMENT OF MICE LETHALLY IRRADIATED WITH GAMMA-RAYS UNDER HIGH DOSE RATE. VII. EFFECTS OF PRECEDING THYMECTOMY ON SYNGENEIC AND ALLOGENEIC BONE MARROW TRANSPLANTATION. Tazawa, Hiroshi; Yamagishi, Morihisa; Wakisaka, Gyoichi (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ., 47: 8-13 (Jan. 1969).

An experimental schedule to prevent secondary disease by thymectomy was presented. It was confirmed that the thymus played an essential role for establishing adoptive immunity in syngeneic radiation chimeras. Thymectomy did not affect the survival rates in syngeneic chimeras. The procedure appeared to be useful for the suppression of the secondary disease in allogeneic chimeras, because the survival rate of thymectomized recipients was better than non-thymectomized ones at 45 days after irradiation, and the difference was statistically significant. (auth)

33661 INHIBITION OF THE EFFECTOR MECHANISM OF TRANSPLANT IMMUNITY BY LOCAL GRAFT IRRADIATION. Wolf, James S.; McGavic, J. D.; Hume, David M. (Medical Coll. of Virginia, Richmond. McGuire Veterans Administration Hospital, Richmond). Contract AT(40-1)-2459. Sur. Gynecol. Obstet., 128: 584-90(Mar. 1969).

A study was performed in which 25 dogs received two kidneys from the same donor, one being placed in the neck and one in the pelvis. One kidney received local x radiation, whereas the other served as an untreated control. A primary rejection response developed in the untreated kidney in the expected time sequence in all the dogs, whereas the irradiated kidney had significant prolongation of survival. It is postulated that the mechanism for immunosuppression by local irradiation is interruption of the mononuclear cell-mediated effector mechanism of graft destruction. (auth)

33662 RADIOIMMUNOASSAY OF SECRETIN IN HUMAN SERUM. Young, J. D. (St. Vincent's Hospital, Sydney); Lazarus, L.; Chisholm, D. J.; Atkinson, F. F. V. J. Nucl. Med., 9: 641-2 (Dec. 1968).

A radioimmunoassay technique using ^{125}I-labeled synthetic secretin, antiserum prepared in rabbits to porcine secretin, and ion-exchange resin to separate the free labeled hormone was developed to measure secretin in human serum. It was shown that a pulse of immunoreactive secretin is released shortly (5 min) after an oral glucose load. (C.H.)

Ecology

Refer also to abstract 33614.

33663 (AAEC/TM-492) STUDIES ON THE PRODUCTIVITY OF THE PHYTOPLANKTON COMMUNITY OF THE WORONORA ESTUARY, NEW SOUTH WALES. Crossett, R. N.; Giles, M. S.; Kerr, J. D. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jan. 1969. 23p. Dep.

Both in situ and laboratory techniques have been used to measure the phytoplankton productivity in the Woronora estuary. During the period from July 1967 to August 1968 the productivity varied between 36 and 470 (μg carbon/l)/day. Chlorophyll a concentration varied between 2.3 and 22.8 μg/l in the same period. Neither parameter showed any clear seasonal trend. Short term experiments detected a well defined periodicity in both productivity and chlorophyll a concentration. Maxima occurred around midday and minima around midnight. The effect of the phytoplankton community on the mobility of radionuclides in the estuary is discussed. (Australia)

33664 (COO-1733-3) A STUDY OF UNSUPPORTED ^{210}Po FOR ION EXCHANGE IN SOIL AND UPTAKE IN VEGETATION. Second Technical Progress Report, August 15, 1968-May 1, 1969. Watters, R. L.; Johnson, J. E. (Colorado State Univ., Fort Collins. Dept. of Radiology and Radiation Biology). May 14, 1969. Contract AT(11-1)-1733. 67p. Dep. CFSTI.

Accidental rupture or burn-up of a ^{210}Po fueled radioisotope generator could result in contamination of the soils of an agricultural area. The ^{210}Po released from an accident would be in an oxide form. Reported data indicate that plants grown in polonium chloride contaminated soil do contain measurable amounts of polonium. To study plant uptake of polonium introduced into the soil as an oxide, vegetables were grown from seed to maturity under greenhouse conditions in soils contaminated with 0.5 to 2.0 nCi/g of soil. The vegetables studied were barley, celery, corn, onion, pea, potato, radish, spinach, tomato and wheat. Stems, leaves, fruits, roots, or tubers from each plant type were analyzed for ^{210}Po in terms of dpm/g dry-weight of control plants and in percent translocation of the polonium from soil to plant. The polonium content of plants grown in a calcareous soil ranged from 0.001 to 0.7 percent of the polonium in the soil. The leafy and stem portion of plants contained most of the polonium with fruits and seeds containing the least. (auth)

33665 (JPRS-47899) RADIOECOLOGICAL RESEARCH IN THE MURUROA ATOLL REGION (TUAMOTU ISLANDS). Kolesnikova, A. N.; Barinov, G. V.; Zesenko, A. Ya. Translated from Radiobiologiya, [9:] 139-43(Jan.-Feb. 1969). 5p. CFSTI.

Investigations were conducted on the radioactivity of plankton in the Tuamotu Archipelago region located to the north of the French atomic testing ground in the Pacific Ocean. Plankton was collected every three months during 1967. Contents of ^{141}Ce, ^{144}Ce, ^{103}Ru, ^{95}Zr, and ^{95}Nb in plankton are tabulated, and a graph is presented to show the gamma spectrum of plankton in the region of the Tuamotu Archipelago. Anomalies in the morphology of the crustacean, Pleuromamma, were studied; there was a direct correlation between the per cent of anomalous individuals and the distance from the test region. (H.L.W.)

Genetics and Cytogenetics

Refer also to abstracts 33813–33815, 33848, and 33907.

33666 (ORNL-TM-2566) BIOLOGY DIVISION QUARTERLY PROGRESS REPORT TO THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, APRIL 1–JUNE 30, 1968. de Serres, F. J.; Webber, B. B. (Oak Ridge National Lab., Tenn.). June 1969. 30p. Dep. CFSTI.

The Neurospora experiment on the Biosatellite-II mission utilized a two-component heterokaryon to study the effect of weightlessness on the production of radiation-induced recessive lethal mutations at two specific loci in the ad-3 region. The overall experiment consists of the genetic analysis of samples flown on the Biosatellite-II mission as well as those used in a series of ground-based control experiments. The analysis of this matrial is incomplete; this report summarizes present data and discusses their implications with regard to the effect of weightlessness on the modification of radiation-induced genetic effects. In brief, present data show that there is little or no effect of weightlessness on the production of radiation-induced recessive lethal mutations in metabolically inactive spores. (auth)

33667 (ORO-3546-8) INFLUENCE OF PHYSICAL STATE OF CHROMATIN ON NUCLEIC ACID AND PROTEIN SYNTHESIS AND ON RADIATION SENSITIVITY OF CELL DIVISION. Comprehensive Report, June 1, 1966–August 31, 1969. Gaulden, Mary Esther (Texas Univ., Dallas. Southwestern Medical School). May 30, 1969. Contract AT(40-1)-3546. 10p. Dep. CFSTI.

Effects of ionic strength of the medium on unirradiated and irradiated neuroblast cells were studied. Results indicated that the uptake of DNA and RNA precursors can be controlled to varying extents, depending on mitotic stage, by experimental alteration of the degree of chromosome condensation with hypertonic medium. Studies on the incorporation of labeled amino acids by the neuroblast indicated that there may be simultaneous incorporation of leucine by the chromosomes and the cytoplasm. Effects of ultraviolet and x radiation on the physical state of chromatin in the neuroblast were investigated. Uptake of tritiated thymidine by cells exposed to 32 R of x radiation in a hypotonic medium was four to five times as great as that by cells in an isotonic medium; these results suggest that the degree of chromosome condensation is a determining factor in the uptake of tritiated thymidine. Studies on the effects of colchicine on mitosis showed that mitotic progress of the cell was affected at points other than at metaphase. Technical aspects of egg storage and tissue culture of neuroblasts are discussed. (H.L.W.)

33668 (ORO-3844-1) EFFECTS OF RADIATIONS ON THE GENETIC SYSTEMS OF ORGANISMS IN RELATION TO THEIR PHYSICAL AND BIOCHEMICAL SYSTEMS. Progress Report, September 1, 1968–May 1, 1969. Alexander, Mary L. (Southwest Texas State Coll., San Marcos. Dept. of Biology). Contract AT(40-1)-3844. 12p. Dep. CFSTI.

The mutagenicity of short-strand DNA and a comparison of the ability of single- and double-stranded DNA to induce recessive lethal mutations were studied by incorporating 0.5 ml of heated (above 65°C) or cold DNA into the medium on which Drosophila eggs were placed and allowed to develop from larvae to the adult stage. Appropriate controls were also maintained. The results indicated that the mere reduction in the size of the DNA molecule did not increase its mutagenicity. It was also concluded that mutagenicity by DNA is dependent upon some factor or factors other than the size of the macromolecules and therefore the preparation of the samples of the same type of DNA cannot account for the variations in results observed for DNA feeding. The efficiency of ethylenimine and x rays and combinations of the two mutagens for producing genetic damage in Drosophila germ cells was studied and results are reported for the following phases of the study: efficiency of ethylenimine or x rays for production of genetic damage in mature sperm, the induction of complete lethals in spermatids by ethylenimine or x rays, the induction of sex-linked and autosomal recessive lethals in mature sperm cells by combined x ray and ethylenimine treatment, the effects of x rays or ethylenimine or both on induction of mosaic sex-linked recessive lethals in either spermatids or mature sperm cells, and the characteristics of the lethals induced in mature sperm cells by ethylenimine. (E.R.B.)

33669 THE EFFECT OF RADIATION ON SMALL COMPETING POPULATIONS OF DROSOPHILA MELANOGASTER. III. CHANGES IN COMPETITIVE ABILITY. Dyer, K. F. (Medical Research Council, Harwell, Eng.). Genetics, 61: 275-91 (Jan. 1969).

The results of experiments on the changing competitive ability of x-irradiated populations of Drosophila melanogaster are given. The numbers of offspring from populations irradiated with 1500 R every generation suggested that the competitive ability of these populations was well maintained over 25 generations and even showed a small increase. Heterozygotes between irradiated and non-irradiated flies showed a marked decrease in competitive ability even though only half of their chromosomes had accumulated genetic damage. Calculations were carried out designed to allow for the distorting effects of genetic deaths due to dominant and recessive lethals thus allowing closer comparison between the irradiated populations, their unirradiated competitors, and the heterozygotes between them. Using the genetic changes occurring within the irradiated population, the decrease in lethal frequencies after the suspension of irradiation, and the difference in genetic constitution of the heterozygotes compared with the irradiated population, the relative fitness of particular heterozygous lethal combinations were examined. In the irradiated populations, chromosomes carrying one lethal did not show any heterozygous disadvantage and non-lethal chromosomes must have had some selective advantage. In the heterozygote population single lethal chromosomes were strongly selected against and non lethal-bearing chromosomes were selectively neutral. The selection coefficients that were derived from this approach were rather more pronounced than suggested from previous studies. Apart from the exaggerating influence of the small size of the present populations the dominating influence on these genotypic and population fitnesses was the continuity or discontinuity of the gene pool from generation to generation. (auth)

33670 THE EFFECT OF RADIATION ON SMALL COMPETING POPULATIONS OF DROSOPHILA MELANOGASTER. II. THE CHANGING FREQUENCIES OF AUTOSOMAL RECESSIVE LETHALS. Dyer, K. F. (Medical Research Council, Harwell, Eng.). Genetics, 61: 245-74(Jan. 1969).

Attempts were made to follow the fate of individual x-radioinduced second chromosome lethals through succeeding generations by means of allelism matings within and between generations. In the irradiated population there were far fewer different mutations present than expected. Many of the lethals reached very high individual frequencies and were very persistent between generations. On suspension of irradiation there was a marked reduction in the number of different lethals although this was not caused by a reduction in the overall frequency. In both cases the variance of mean lethal gene frequency was lower than expected, emphasizing positive selection for a proportion of the lethals. As expected there was an accumulation of more than one lethal per chromosome although there was a deficiency of chromosomes carrying two or more lethals. The heterozygote samples exhibited a greater degree of allelism and had an excess of chromosomes carrying two or more lethals. Matings between the irradiated and heterozygote samples revealed a very low degree of allelism. It appears there was a somewhat different sample of lethals in the two populations. In all cases there appeared to be a relationship between gene frequency and number of lethals carried, such that the most frequently occurring chromosomes accumulated more than one mutation but were preferentially eliminated when they had three or more lethals. The overall distribution of gene frequencies showed only a moderate agreement with small population theory, there being an excess of high frequencies. It is suggested that favorable and heterotic gene complexes can be formed and preserved under certain circumstances in the integrated gene pool of the irradiated population. The advantageous genetic changes appear to have a selective advantage of about 20%, while the disadvantageous changes appear to have a selective disadvantage of about 10%. The heterozygote population provides an unfavorable genetic background for most of the induced changes that have selection coefficients against them of up to 75%. It is emphasized that there can never be stability in the genetic material under these conditions, but the model recently suggested by Kimura and Maruyama of epistatic gene interactions is not inconsistent with some of the characteristics found in the present populations. (auth)

33671 THE EFFECT OF RADIATION ON SMALL COMPETING POPULATIONS OF DROSOPHILA MELANOGASTER. I. THE ACCUMULATION OF GENETIC DAMAGE. Dyer, K. F. (Medical Research Council, Harwell, Eng.). Genetics, 61: 227-44(Jan. 1969).

Two populations of Drosophila melanogaster, genetically similar but phenotypically distinguishable, were allowed to compete in the same population cages for a number of successive generations. The populations were set up with 50 adults each at every generation. At every generation after the first, those flies in excess of 50 that hatched from each population and all the heterozygotes between the populations were used to test for the accumulation of genetic damage. This genetic damage was induced by irradiation, at the commencement of each generation, all the adults from one of the populations with 1500 R x rays. Under those conditions

sterility increased at approximately 1% per generation and there was a slow but definite accumulation of sex-linked lethals. Induction of second chromosome recessive lethals was about 6% per generation but the net rate of accumulation appeared to be about 4.4%. By generation 25, equilibrium was almost reached at just below 70% recessive lethal chromosomes, whereas a set of calculations using some extracted population parameters suggested equilibrium might be reached at about 55%. Further studies were confined to this class of genetic changes. Allelism matings were carried out between selections of lethals retained at each generation and these showed a high degree of identity of lethals, with a rate of elimination considerably in excess of the rate of induction. It was concluded that some lethal mutations must have marked heterozygous advantage to account for these two discrepancies. These conclusions were supported by results in a population where radiation was suspended. Among the heterozygotes between the two populations, however, the number of lethals was lower than expected and in this case it was suggested that the discontinuous genetic background resulted in stronger selection against nearly all lethals. (auth)

33672 EFFECTS OF PRETREATMENT WITH X RAYS ON PARAMUTABILITY OR PARAMUTAGENICITY OF CERTAIN R ALLELES IN MAIZE. Shih, Katherine Lu (Univ. of Wisconsin, Madison). Genetics, 61: 179-89(Jan. 1969).

Evidence showed that when pollen from plants homozygous for either paramutable standard R^r or paramutagenic R^{st} was x-irradiated, paramutation was altered in the heterozygotes into which these alleles were subsequently introduced. Paramutation was reduced in 27% of the plants carrying the x-irradiated R^r resulting from the 1,200 R pollen treatment. There was no case, however, in which paramutation was completely lost. Eighteen and 30% of the treated R^{st} pollen grains from two $R^{st}R^{st}$ plants (out of seven) were significantly reduced in potential paramutagenic action. Nine R^{sc} alleles were found to be generally insensitive to x irradiation at the seed stage (14,000 R). The allele derived from one of the 68 irradiated seeds was exceptional, however, and showed a possible increase in paramutagenicity. Two paramutagenic $r^r(I)$ alleleles were also studied. Paramutation of R^r_I was reduced in $R^r_I/r^r(I)_5$ heterozygotes when the strongly paramutagenic $r^r(I)_5$ was x-irradiated at the seed stage with 14,000 R. Such a reduction did not occur, however, in R^r_I heterozygotes carrying the irradiated weakly paramutagenic $r^r(I)_3$ allele. Thus sensitivity to x irradiation appears to vary among different paramutagenic alleles. (auth)

33673 EFFECTS OF X-IRRADIATION ON ALEURONE PIGMENTING POTENTIAL OF STANDARD R^r AND A PARAMUTANT FORM OF R^r IN MAIZE. Shih, Katherine Lu; Brink, R. Alexander (Univ. of Wisconsin, Madison). Genetics, 61: 167-77(Jan. 1969).

Irradiation of R^rR^r seeds (10,000 R) and R^r pollen (1,200 R) did not produce a detectable effect on the pigmenting potential of the standard R^r allele. The pigmenting potential of a strongly repressed $R^{r'''}$ allele, on the other hand, was partially restored, and to different levels, after x irradiation of $R^{r'''}$ $R^{r'''}$ seeds (6,000 R, 8,000 R, and 10,000 R) and of $R^{r'''}$ pollen (1,200 R and 1,400 R). Complete restoration of $R^{r'''}$ to the pigmenting level of standard R^r, however, rarely occurred. The frequencies of detectable increases in aleurone pigmentation were 21% in the immediate testcrosses of the treated seeds (10,000 R) and 12% in the immediate testcrosses of the treated pollen (1,400 R). The pigmenting potential of the $R^{r'''}$ allele was also increased following x irradiation of heterozygous $R^{r'''}$ r^s seeds (10,000 R to 19,000 R). Tests showed that the x-radioinduced increases in pigmentation were heritable and also were R-locus dependent. Furthermore, paramutant alleles whose pigmenting ability had been significantly increased by x irradiation were still potentially paramutable. The experimental results are in accord with expectation on a hypothesis that level of pigmenting potential of a paramutable R allele is a function of the number of repeating units composing a repressor segment adjacent to the R gene. (auth)

33674 CONTROL OF PAIRING IN MAIZE AND MEIOTIC INTERCHROMOSOMAL EFFECTS OF DEFICIENCIES IN CHROMOSOME 1. Baker, R. L.; Morgan, D. T. Jr. (Univ. of Maryland, College Park). Genetics, 61: 91-106(Jan. 1969).

Fifteen of 44 X_1 hemizygotes of maize from zb_4 P^{ww} As $br_1 \times Zb_4$ P^{ww} As Br_1 were variably asynaptic. Asynapsis was attributed to loss of As in the x-irradiated chromosome 1 contributed by the pollen. Direct evidence for loss of As was obtained by the occurrence of three asynaptic monosomes deficient for all dominant morphological markers. The other asynaptic hemizygotes were ascribed to deletion of As in conjunction with one or more linked genes. Syncytes, attenuated metaphase I, curved spindles, failure of cytokinesis, and other meiotic irregularities characteristic of homozygotes for the recessive mutant as occurred in asynaptic hemizygotes. It is suggested that the recessive mutant is a hypomorph. Initial failure of synapsis rather than later disassociation of homologs was inferred from the occurrence of microsporocytes with dual nucleoli at diakinesis. Since a single dose of As can result in univalents, it is concluded that the diploid dose is regulatory for the orderly sequence of synapsis in normal stocks of maize. (auth)

33675 EFFECT OF TEMPERATURE ON THE LEVEL OF CHROMOSOME ABERRATIONS IN CANCER CELL CULTURE. Kuzmina, E. G.; Poryadkova, N. A. (Inst. of Medical Radiology, Obninsk, USSR). Vop. Onkol., 15: No. 3, 39-45(1969). (In Russian).

The influence of suboptimal temperature on HEp-2 cells cultured in vitro was studied with respect to the yield of observable chromosome aberrations. Maintaining the cultures at room temperature increased the number of aberrant cells above that of the control cultures. This is in keeping with the hypothesis that cancer cells contain latent injuries of their genetic system that can be transformed with some probability, depending upon the environmental conditions, into visible changes. The same treatment of γ- or x-irradiated cells also increased the number of injured cells. However, the mean number of injuries per injured cell remained the same. This result indicates that the manifestation of radioinduced latent injuries follows the all-or-none principle. Inhibition of the colony-forming ability of cells under the influence of low temperature both by spontaneous or radioinduced mutagenesis is related to the manifestation of latent injuries to the genetic structures by visible chromosome changes. (E.R.B.)

33676 RADIATION-INDUCED POLYGENIC MUTATION IN ARABIDOPSIS THALIANA. II. ANALYSIS OF LINES SELECTED FOR FLOWERING TIME. Lawrence, C. W. (Atomic Energy Research Establishment, Wantage, Eng.). Heredity, 23: 573-89 (Nov. 1968).

Genetic analysis of inbred lines of A. thaliana containing radiation-induced mutations in the polygenic system influencing flowering time was carried out by means of sets of diallel crosses. Selection in both the early and late flowering direction was initiated in families obtained by self-pollinating single plants irradiated as seed with 90 KR of ^{60}Co γ rays. Selection continued from the second to the sixth generation inclusive after treatment. In the R group of lines, seed from selected plants were reirradiated with a dose of 90 KR in each generation up to and including the fifth. Most of the variation between the lines arose from the additive effects of the mutations (general combining ability) but significant nonadditive variation (special combining ability) was also found. Most mutations were recessive to their wild type alleles, but dominant mutations were also found. Deletions cannot therefore give rise to all of the variation and it is possible that they are of relatively minor importance in this context. Mutations in the late flowering selection lines were generally recessive to those in the early flowering lines, a situation which probably reflects the average dominance relation among wild type alleles. In general, these relatively unselected samples of radiation-induced mutations possessed properties similar to those of their spontaneous counterparts. Whether this is because such mutations merely result from addition or loss of pre-existing genetic materials, or its rearrangement, or because genotypes have become adapted to recurrent mutation, is not known. (BBB)

33677 DEOXYRIBONUCLEIC ACID BASE COMPOSITION IN THE TAXONOMY OF STAPHYLOCOCCUS. Garrity, Francis L.; Detrick, Barbara; Kennedy, E. R. (Catholic Univ., Washington, D. C.). J. Bacteriol., 97: 557-60(Feb. 1969).

Twenty-four strains of Staphylococcus aureus, including eight known mutants of S. aureus and strains growing under a variety of environmental conditions or exposed to a number of physical and chemical agents, maintained a remarkably narrow range of guanine plus cytosine (GC) content (32.4 to 35.1%). The wide range of GC content (30.7 to 40%) reported in the literature was due to the variety of methods and calculations used rather than to any substantial variation in base composition. The UV-2 mutant (ATCC 13680) with a GC content of 67.6% reported to be derived from S. aureus (ATCC 13679) was a species of Corynebacterium. The data presented were consistent with the concept that base composition changes only to a very slight degree by mutation. (auth)

33678 REPAIR OF ULTRAVIOLET RADIATION DAMAGE IN SENSITIVE MUTANTS OF MICROCOCCUS RADIODURANS. Moseley, B. E. B. (Oak Ridge National Lab., Tenn.). J. Bacteriol., 97: 647-52(Feb. 1969).

Various aspects of the repair of ultraviolet (uv) radioinduced damage were compared in wild-type Micrococcus radiodurans and two uv-sensitive mutants. Unlike the wild type, the mutants were more sensitive to radiation at 265 nm than at 280 nm. The

delay in deoxyribonucleic acid (DNA) synthesis following exposure to uv was about seven times as long in the mutants as in the wild type. All three strains excised uv-radioinduced pyrimidine dimers from their DNA, although the rate at which cytosine-thymine dimers were excised was slower in the mutants. The three strains also mended the single-strand breaks that appear in the irradiated DNA as a result of dimer excision, although the process was less efficient in the mutants. It is suggested that the increased sensitivity of the mutants to uv radiation may be caused by a partial defect in the second step of dimer excision. (auth)

33679 A PHOTOREACTIVATIONLESS MUTANT OF SACCHAROMYCES CEREVISIAE. Resnick, Michael A. (Univ. of California, Berkeley). Photochem. Photobiol., 9: 307-12 (Apr. 1969).

A mutant of Saccharomyces cerevisiae was isolated that is incapable of photoreactivating uv-radioinduced lethal damage. The mutant resulted from mutation of the chromosomal gene PHR 1, that was determined to be dominant. This gene is involved with the production of photoreactivating enzyme. (auth)

33680 ORIGIN AND BEHAVIOUR OF RINGS OF 4 AND 6 CHROMOSOMES DURING MEIOSIS OF PISUM. Gottschalk, W. (Univ. of Bonn). Nucleus (Calcutta), 11: 61-74(June 1968).

Five x radioinduced mutants of Pisum sativum are described that were characterized by a reciprocal translocation resulting in producing an association of four chromosomes during meiotic prophase and metaphase I. The meiotic behavior and the fertility of the plants heterozygous for the translocated chromosomes were analyzed. Not only the semisterility expected but a high degree of additional cytological anomalies were found causing a strong reduction of the proportion of functionable male and female germ cells. The x-radioinduced mutant 77A was characterized by forming a ring or a chain of six chromosomes in the pollen mother cells which is due to the presence of three translocated chromosomes in each cell. In general, the meiotic behavior of this mutant agreed with the behavior of the mutants of the first group but the proportion of meiotic irregularities was even higher resulting in a more drastic reduction of the percentage of functional germ cells. A 1 : 1 segregation of fertile : partially sterile plants was found in the progenies of mutant 77A. Considering mutant 62B, however, which belongs to the first group, a considerable surplus of partially sterile plants was observed. The causes of this deviation from the 1 : 1 ratio expected could not yet be clarified. (auth)

33681 GENETIC VARIATION IN GASTRIC LESIONS OF SWINE. Conley, Gary Olen. Ames, Iowa, Iowa State Univ., 1968. 74p.

Thesis.

The influence of various factors on the incidence and severity of gastric lesions in swine are presented. Estimates of genetic variance were calculated. Among the factors studied were the effects of electric shock, season of slaughter, sex, gastric pH, backfat probe, temperature ranges, breed, and radiation. The x irradiation of sires had no significant effect on formation of lesions in their progeny. (M.M.B.)

33682 A CHROMOSOME STUDY OF PIGS DERIVED FROM IRRADIATED MALE SWINE AND SEMEN. Zartman, David Lester. Columbus, Ohio, Ohio State Univ., 1968. 148p.

Thesis.

To ascertain the extent to which x-radioinduced chromosomal aberrations in germ line cells may be transmitted, metaphase cells from the progeny of boars whose testes or semen had been irradiated were studied. The effect of other variables on the frequency of chromosomal aberrations in cells of the pigs produced from gametes emanating from irradiated cell lineages was also determined. These variables were: proportion of the genome x-irradiated, breed, sex, season of birth, and dam's parity. The experiment consisted of two portions, i.e., two studies were completed. One was a study of fibroblasts cultured from the stillborn progeny of males with treated testes (300 R). The second was a study of cultured leukocytes from pigs derived from x-irradiated, fresh semen (600 R/semen sample). There were 108 stillborn pigs from which successful fibroblast cultures were obtained. An average of seven cells were analyzed per sample; thus, 779 cells were observed. The second experiment included successful leukocyte cultures from 27 live pigs produced from treated semen and 11 pigs with unexpected blood types which were used as a control group. Thirty cells were examined from each of the samples except one which had only nine. In all, 1119 cells were observed for this portion of the study. Chromosome aberrations were classified in nine categories which are listed below. A computerized least-squares analysis of variance was used to test the data obtained. Each category of aberration was treated as a separate dependent variable. Some additional analyses were performed. The mean frequencies per cell for each type of chromosome aberration in fibroblasts of the stillborn animals whose sires (or more remote ancestors) had been irradiated were: number of chromosomes (37.82), fragments (0.1), chromosome breaks (0.17), chromatid breaks (0.02), chromosome gaps (0.05), chromatid gaps (0.02), uncommon secondary constrictions (0.02), pericentric inversions (0.03), and sister chromatid fusions (0.01). Comparable values in leukocytes from live born pigs half of whose genomes were irradiated as gametes were: number of chromosomes (37.87), fragments (0.05), chromosome breaks (0.12), chromatid breaks (0.04), chromosome gaps (0.02), chromatid gaps (0.03), uncommon secondary constrictions (0.002), pericentric inversions (0.02), and sister chromatid fusions (0.008). Of the cells observed in the first experiment, 23.11% were aneuploid, and 10.55% were aneuploid in the second experiment. The chromosomes in identifiably separate groups were randomly ($P > 0.10$) involved in aneuploidy. However, there were significant ($P < 0.05$) differences in the frequencies of breakage of different chromosome group members. A number of first order interactions between independent variables were found to produce significant ($P < 0.10$) differences in frequencies of some aberrations. Cells from males usually had fewer aberrations than did those from females. Seasonal effects were significant in the irradiated testes experiment. A higher frequency of aberrations was observed in cells from pigs born in the spring than from those born in the fall. There was a threshold-like inhibition of aberrations attributable to irradiation of semen when the testes producing the sperm had also been irradiated. This effect was probably a consequence of cell selection. Of especial interest were seven of the 31 live pigs derived from irradiated semen. All observed cells from four of them contained large chromosome rearrangements, i.e., translocations (3) and a pericentric inversion. The other three were mosaics for a chromosome segment deletion. Two of these were by the same sire and may have inherited a predisposition for the condition. The frequency of non-diploid but euploid cells in the samples tested during the second experiment was not altered significantly ($P > 0.10$) by any of the variables tested. The mean frequency of euploid, non-diploid cells per animal was 0.62. The sex proportion of 333 stillborn pigs was 48.05% males. This proportion was influenced by maternal effects via breed × parity interactions ($0.05 > P > 0.01$). (Disser. Abstr.)

33683 INDUCTION OF MONOSOMES AND MUTATIONS IN COTTON BY GAMMA IRRADIATION OF POLLEN. Galen, Donald F.; Endrizzi, J. E. (Univ. of Arizona, Tucson). J. Hered., 59: 343-6(Nov.-Dec. 1968).

Cytological data are presented to arrive at an approximate dose level for the efficient production of monosomes in cotton. A second study was conducted concurrently to determine the cytological characteristic of plants exhibiting radiation-induced mutations at specific loci. Pollen from Texas 586, a multiple dominant marker line was treated with 400 and 1200 R ^{60}Co γ radiation. Irradiated pollen was used to pollinate in each case 12 to 15 emasculated flowers of Texas 582, a multiple recessive stock. The F_1 contained from zero to several chromosomal structural changes. The F_1 plants with one or more structural changes are described in detail. There was one with a single monosome (25II + I); several with one or two monosomes in addition to a heteromorphic bivalent or one or more translocations; and a large number with one or more heteromorphic bivalent or one or more translocations; a large number with one or more heteromorphic bivalents and/or one or more translocations. The heteromorphic bivalents in all cases except one consisted of a normal chromosome and a telocentric chromosome in which one arm had been deleted. The frequency of monosomes was 8.9% at the 400 R level and only 3.7% at the 1200 R level. The data showed that in the cytologically analyzed F_1's, 92% of the mutants were in plants with visible chromosome deficiencies, which demonstrated that most mutants from dominant to recessive in this study could be attributed to deletion of the chromosome or chromosome segment carrying the dominant allele. (BBB)

33684 MUTATION OF GENE FOR NAKED SEED IN COTTON. Duncan, E. N.; Maner, B. A. Jr.; Lewis, C. F. (Tennessee Agricultural Experiment Station, Knoxville). J. Hered., 59: 368(Nov.-Dec. 1968).

Seeds of cultivated varieties of American upland cotton (Gossypium hirsutum) are covered by long lint hairs and short "fuzz" hairs. Ginning removes the lint, but leaves the seeds covered with the fuzz hairs. Stocks with fuzzy seed are homozygous for the recessive gene (n). Lines with the dominant mutant (N) do not produce fuzz. After ginning, the seed coat is naked. Texas 586 is a multiple dominant marked line containing 8 dominant mutants including N^1. To study the heritability of this anomalous character, 9 fuzzy-seeded F_2 plants were backcrossed with Texas 586. Eight of the backcrossed progeny were naked-seeded and one segregated 5 naked to one fuzzy. A study was initiated to isolate lines of Texas 586 with the mutable (N) gene. Seven % fuzzy-seeded F_1 plants occurred in a control population of crosses with M8, a double haploid

Deltapine (G. hirsutum) X Texas 586 mass selfed. When F_1 seed were γ irradiated at 40 Krad, 13.6% of the plants were fuzzy-seeded. When F_1 seed were irradiated with 2800 rad of fast neutrons, 20% of the plants were fuzzy-seeded. Texas 586 apparently has something in its genetic background that causes N to mutate to n, but this factor has not been isolated. (BBB)

33685 ENVIRONMENTALLY INDUCED VARIATIONS IN X IRRADIATION RESISTANCE OF A SACCHAROMYCES MUTANT. Schaedel, U.; Laskowski, W. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.). Zentralbl. Bakteriol. Parasitenk., Abt. I Orig., 205: 54-61(1967). (In German).

The relative resistances of 2 haploid strains and 2 antidiploid strains of Saccharomyces to x irradiation were studied. The haploid strain spontaneously mutated from the prototrophic to auxotrophic type, and each of these produced the corresponding diploid strain by endomitotic diploidization. Differences in radioresistance were evoked in glucose-yeast-peptone media. Increases in glucose concentration of the preculture media from 0.25 to 2% increased the radiosensitivity of the auxotrophic diploid strain as compared to the wild type. The radiosensitivity of the haploid strain was not affected by this treatment. At low glucose concentrations the mutant was more radioresistant than the wild type. At 0.5% glucose concentration both strains had ~ the same radioresistance. The LD_{10} of the mutants was minimal at from 1 to 4% glucose, while the LD_{10} of the wild type approached a maximum limit at ~ 2% glucose concentration. Equal radioresistance was observed with 8% glucose. Similar, though not identical, effects on radioresistance were observed when the yeast extract concentrations of the preculture medium were varied. (BBB)

33686 TRANSFORMATION OF NUTRITIONALLY DEFICIENT MUTANTS OF ASPERGILLUS NIGER. Sen, Kalyani; Nandi, P.; Mishra, A. K. (Bose Inst., Calcutta). J. Gen. Microbiol., 55: 195-200(Feb. 1969).

In transformation experiments, 6 biochemical mutants derived through uv radiation of A. niger were used as the recipient strains. The strains were 2 nic^-, 3 lys^-, 4 leu^-, 14 met^-, 21 cho^-, and 45 arg^- requiring nicotinic acid, lysine, leucine, methionine, choline, and arginine, respectively. It was shown that reversions occurring in the nutritionally deficient mutants were due to transformation of the mutants to wild type and that this reversion rate was affected if the donor DNA was treated with heat, DNAase, or uv irradiation (2537 Å). Reversions to wild type occurred when conidia of the deficient mutants were treated with DNA from the wild-type strain. No reversions or wild-type colonies were obtained when an equivalent number of conidia from deficient strains were either treated with the same DNA as the recipient, or were plated without any DNA treatment. Increase in the percentage of transformation was observed up to 6 μg/ml of donor DNA. The transforming activity of the donor DNA was inhibited by the action of the uv radiation. There was a decrease in the transformation activity with successive increase in the time period of uv irradiation. (BBB)

33687 RADIONUCLIDES IN HORTICULTURE. Glubrecht, H. (Technische Hochschule, Hanover). pp 419-30 of Proceedings of 17th International Horticulture Congress, College Park, Md., 1967.

See CONF-660826.

The production of mutations by low irradiation doses, the application of very high doses for the sterilization of food, and the direct exploitation of very low doses of radiation to promote germination and growth in plants are discussed briefly. Irradiation is one method of inducing mutations in breeding. In many plants radiation produces mutation spectra which differ considerably from those produced by other mutagens, such as chemicals. Some types of radiation, especially neutrons have been little used, though they seem to be very promising. The irradiation of food can destroy pathogenic agents. To prevent their growth in potatoes and onions irradiation doses of about 10^5 R are enough. To destroy them doses of 10^6 to 10^8 R are needed. In many cases irradiation of food seems to be economical and safe. Eradication of pathogenic insects by means of irradiation of male individuals has already become economical. To influence the growth and often the yield of plants effective doses lie between 10 and 1000 R. Broad beans in a field exposed to a γ-ray source at temperatures of 12 ± 0.1°C received different daily doses up to 30 R/day maximal. After four days of radiation treatment the plants exposed to about 15 R/day, and after 12 days the plants exposed to about 8 R/day showed 10% increased growth. These effects seemed to occur chiefly under suboptimal conditions. If appropriate methods could be worked out, it would be relatively easy to apply small doses of radiation to seeds. (BBB)

33688 ON THE MECHANISM OF ULTRAVIOLET-LIGHT ACTION ON ESCHERICHIA COLI RECOMBINATION. Bednarska, Marta; Kwiatkowski, Zbigniew (Warsaw Univ.). Acta Microbiol. Pol., 17: 337-40(1968).

The possible role of pyrimidine dimers in the stimulating effect of uv irradiation on bacterial recombination was studied. Two F^- strains of Escherichia coli were used, WP2, a tryptophan-requiring derivative of E. coli B/r and WP2, (also known as WP2 hcr^-) which is a uv-sensitive mutant isolated from WP2. WP2, strain does not excise pyrimidine dimers or it does so at a markedly reduced rate. This uv-induced damage although unexcisable in the dark is removed in visible light by splitting of pyrimidine dimers by the photoreactivating enzyme. Strain WP2 which is uv resistant excises pyrimidine dimers from its DNA. Strain AB 311 was used as a donor. Try^+ recombinants were selected. Ultraviolet radiation doses were 5, 10, and 20 erg/mm². Recipient bacterial cells were irradiated and immediately mated with untreated donor. The results showed that in the uv-sensitive (hcr^-) strain irradiation had a marked effect on the succeeding conjugation. This was reflected by the decreased number of selected recombinants. When the uv-resistant strain was used as a recipient, the same doses of uv showed no effect on the number of recombinants. The decrease of recombination frequency under the influence of uv is presumably due chiefly to pyrimidine dimer formation. The mere presence of pyrimidine dimers in DNA is not responsible for the stimulation of genetic recombination with uv irradiation. (BBB)

33689 RECOMBINATION DEFICIENT MUTANTS OF ESCHERICHIA COLI K12 THAT MAP BETWEEN thyA AND argA. Emmerson, Peter T. (Yale Univ., New Haven). Genetics, 60: 19-30(Sept. 1968).

Three nitrosoguanidine-induced, radiation sensitive, recombination deficient mutants of E. coli K12 were found to degrade their DNA less than wild-type cells when incubated following either uv or x irradiation. In this respect, they differ from recombination deficient mutants defective at the recA locus, that were shown to degrade their DNA to a much greater extent than wild-type cells following irradiation. The three mutant alleles, two of which were designated recB and recC, were shown to map between thyA and argA. (auth)

Health Physics and Safety

Refer also to abstracts 33569 and 33573.

33690 (MLM-1596) METHOD FOR DETERMINING THE PARTICLE SIZE OF AIRBORNE DUST. Meyer, C. T.; Anderson, H. F.; Kahle, J. B. (Mound Lab., Miamisburg, Ohio). June 1, 1969. Contract AT(33-1)-Gen-53. 8p. Dep. CFSTI.

A technique was developed to determine particle sizes of airborne particulates using electron microscopy techniques. Particle sizes were determined by comparing photomicrographs of polystyrene spheres of known diameters with photomicrographs of the particulates. (auth)

33691 PRINCIPLES OF RADIOLOGICAL HEALTH. Gloyna, Earnest F.; Ledbetter, Joe O. Environmental Health Engineering Textbooks. New York, Marcel Dekker, Inc., 1969. 489p. $14.50. (NP-17928).

Topics discussed include atomic structure; radioactive processes; radiological reaction times; interaction of radiation with matter; radiation dosage; principles of detection; statistics of radiation measurement; techniques of measurement; effects of ionizing radiations including physical, chemical, and biological; environmental transport of radionuclides; radiation protection methods; radioactive wastes management; x rays; and hazards of nonionizing radiations. (W.H.K.)

Radioactive Contamination and Decontamination

Refer also to abstracts 33181, 33602, 33603, 33606, 33702, 33718, and 33684.

33692 (CEA-R-3698) STUDY OF THE ARTIFICIAL RADIOACTIVITY OF THE MARINE MEDIUM USING GAMMA SPECTROMETRY (1962-1966). Chesselet, Roger (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1969. 117p. (In French). Dep.

Thesis. Submitted to Paris Univ., France.

The radioactivity of ^{141}Ce, ^{144}Ce, ^{95}Nb, ^{144}Pr, ^{103}Ru, ^{106}Ru, and ^{95}Zr present in atmospheric fallout between 1962 and 1964 and their incidence in superficial marine waters were studied. Physical, chemical, and biological processes were studied using gamma ray spectrometry. Accumulation in the planktonic biomass and diffusion toward deeper waters were controlled by the quantity of radioactive particles in the soluble phase in seawater. A spectrometry method is described which allows direct mea-

surement in the sea of very low concentrations of some gamma ray emitters. The application of the method made it possible to carry out numerous observations in the surface waters of the Western Mediterranean sea and in the Bay of Biscay. It was shown that the mixing depth was closely connected to the depth of the thermocline. The diffusion coefficients were similar to the thermal turbulent coefficient. A comparative study showed that the rate of radioactive fallout on the maritime zone was always two to three times higher than on neighboring continental regions. Explanations of this phenomenon are discussed. (auth)

33693 (NP-17914) DATA FROM RADIATION PROTECTION PROGRAMS. Volume 6, Number 12. (Department of National Health and Welfare, Ottawa (Ontario). Radiation Protection Div.). Dec. 1968. 34p. Dep.

Data are tabulated on the total β activity from fallout in samples of air and precipitation on ^{137}Cs and ^{90}Sr contents of samples of milk collected at various locations in Canada during November and December 1968. Slight increases in activities of air samples on December 12–14 were attributed to an underground nuclear explosion at Nevada Test Site on December 8. Average values for precipitation remained insignificantly low. Levels of ^{90}Sr and ^{137}Cs in milk were 11.1 and 916 pCi/l and 24 and 27 pCi/l for November and December, respectively. Data from monitoring programs at reactor sites were in general agreement with observations made in the fallout program; no anomalies were shown that could be attributed to contamination from reactors. (C.H.)

33694 (SFL-A-12) STUDIES ON ENVIRONMENTAL RADIOACTIVITY IN FINLAND, 1967. Annual Report. (Institute of Radiation Physics, Helsinki (Finland)). Dec. 1968. 30p. Dep.

Separate abstracts were prepared for each of the three sections of this annual report for inclusion in NSA. (C.O.)

For abstracts of individual sections see: 33695–33697.

33695 (SFL-A-12, pp 2-11) ^{90}Sr AND ^{137}Cs IN WATER. Salo, Anneli (Institute of Radiation Physics, Helsinki (Finland)).

The results of strontium-90 and cesium-137 analyses of precipitation, surface water, sea water and drinking water are given for the year 1967. The total deposition of strontium-90 was 0.70 mCi/km^2 and of cesium-137 0.99 mCi/km^2, which means that the level of the year 1961 was reached. The average concentrations of strontium-90 and cesium-137 in surface water were 1.5 pCi/l and 0.4 pCi/l respectively. (auth)

33696 (SFL-A-12, pp 12-26) RADIOACTIVITY OF FINNISH MILK, 1967. Castren, O.; Paakkola, O. (Institute of Radiation Physics, Helsinki (Finland)).

Results of a country-wide survey of strontium-90 and cesium-137 in milk in Finland are presented. During 1967 the annual means weighted for production were: ^{90}Sr 10.4 pCi/g Ca or 12.5 pCi/litre of consumption milk and ^{137}Cs 67 pCi/g K or 106 pCi/litre. Annual averages for the different areas are for ^{90}Sr about 20 per cent and for ^{137}Cs about 30 per cent lower than the corresponding values for 1966. The ratio $^{137}Cs/^{90}Sr$, expressed in pCi/g K and pCi/g Ca, has been calculated as a monthly average in different sampling areas. This ratio varies between 2 and 16. (auth)

33697 (SFL-A-12, pp 27-30) THE ^{137}Cs LEVEL IN THE CONTROL GROUP OF THE INSTITUTE OF RADIATION PHYSICS, 1967. Suomela, Matti (Institute of Radiation Physics, Helsinki (Finland)).

A control group of 26 persons has been measured with a whole-body counter to determine their cesium-137 and potassium-40 body burdens. The control group was measured for the first time in October, 1965. The results of measurements taken in 1965 and 1966 are reported in Report SFL-A8/2/. The results of measurements of the control group in 1967 are given in this report. The annual mean value for the Cs/K ratio of women and men in 1967 was 112 pCi/g. This value decreased by 25 per cent from the annual mean value of 1966. (auth)

33698 RADIOACTIVE LEAD IN THE ENVIRONMENT AND IN THE HUMAN BODY. Jaworowski, Z. (Inst. of Nuclear Research, Warsaw). At. Energy Rev., 7: No. 1, 3-45(1969).

A summary is given of the results of studies performed during the last decade on the behavior, occurrence, and sources of ^{210}Pb in naturally and artificially contaminated humans and environment. The data on the levels of ^{210}Pb in the atmosphere, rain, potable and surface water, and in human and animal food are discussed. The patterns of the distribution of radioactive and stable lead in the body and the data on intake, elimination, and other metabolic parameters are reviewed. The problem of ^{210}Po born from its parent ^{210}Pb in the tissue is also discussed, as well as the radiation dose attributable to this source. Special attention is paid to studies on professional exposure to ^{210}Pb in uranium mines. (auth)

33699 URANIUM (NATURAL) AND ITS COMPOUNDS. Amer. Ind. Hyg. Ass. J., 30: 313-17(May-June 1969).

Following a brief discussion of the significant physical properties of natural uranium (combination of ^{234}U, ^{235}U, and ^{238}U) including its radiation emissions and specific activity, the hygienic standards, toxic properties, industrial hygiene practices, and medical information relating to natural uranium are outlined. The hygienic standards include: recommended maximal atmospheric concentrations, short exposure tolerance, and atmospheric concentration immediately hazardous to life. Toxic properties of uranium are outlined in relation to inhalation, skin contact, eye contact, and ingestion. The industrial uses, exposure evaluation methods, and probable hazards and their control are stated. The medical information relates to emergency treatment in cases of uranium exposure. (E.R.B.)

33700 THE ACCUMULATION AND RETENTION OF ^{90}Sr IN HUMAN TEETH IN ENGLAND AND WALES: 1959 TO 1965. Starkey, W. E. (Dental School, Bristol, Eng.); Fletcher, W. Arch. Oral. Biol., 14: 169-79(Feb. 1969).

Strontium-90 accumulation in human teeth is reported for samples collected between January 1963 and December 1965. Only clinically perfect teeth, i.e., premolars from persons 9 to 13 yr old and third molars from persons 17 to 21 yr old, were used. Roots and crowns were divided, bulked according to age group, and analyzed separately. Continuous results are now available for over 11,000 teeth collected from all parts of the United Kingdom. The rate of fallout was negligible before 1953 but between 1954 and 1964 world-wide deposition of ^{90}Sr increased from 0.10 to 11.58 MCi, which was reflected in the findings. Concentrations in the teeth (estimated in pCi/gCa) steadily increased with the passage of time. At any given point it was highest in the teeth of the youngest groups since these were obtained in an active state of mineralization during a period when dietary levels were rising. Similarly, in any given age group, concentrations were higher in the roots than in the crowns because the roots were affected by recent uptake whereas the crowns had mineralized when dietary levels were relatively lower. Since the crowns related to previous uptake, it was possible to deduce the probable activity of ^{90}Sr during mineralization for the years 1956–1959. When the results were related to longitudinal uptake in children of the same age, it was found that the ratio of $^{90}Sr/Ca$ in teeth of individuals has been steadily rising although not so steeply as with age groups born in successive years. (BBB)

Dosimetry and Monitoring

Refer also to abstracts 33381, 33416, 33540, 33732, 33765, and 33771.

33701 (AECL-3284) BIOLOGY AND HEALTH PHYSICS DIVISION PROGRESS REPORT, OCTOBER 1–DECEMBER 31, 1968. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). 70p. (PR-B-80). Dep. CFSTI. CAN $1.50.

Advances in the development of instruments and techniques for radiation detection are traced. Developments have been applied to radiobiology and other areas of atomic energy. The heart of a health physics instrument is the radiation detector and its choice and mode of application will dictate the overall design to extend over a wide range of dose and count rates. Semiconductor detectors have received increasing attention including those which amplify internally. In 1964 research began on the application of thermoluminescence dosimeters for personnel and biological dosimetry. Their small size, long memory, and absence of auxiliary equipment make them attractive in these applications. Other advances in improved circuit techniques are described. In all, more than 30 health instruments have been completed and are available for construction from engineering drawings. Eight others are in various stages of development. Emphasis will be placed on specialized instruments not available from the commercial market. Developments in biology and environmental research are also outlined. (Canada)

33702 (BNWL-983(App.)) EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD FOR 1967. Wooldridge, C. B. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Feb. 1969. Contract AT(45-1)-1830. 139p. Dep. CFSTI.

This report is a supplement to BNWL-963, and presents a compilation of results obtained from both radiochemical analyses of environmental samples and from radiological measurements made in the Hanford environs during 1967. The data are presented in tabular form and are divided into nine sections as follows: concentration of radionuclides in Columbia River water

and estimated rate of transport of radionuclides in Columbia River; concentration of radionuclides and total β activity in drinking water in vicinity of Hanford; concentration of radionuclides in muscles of fish taken from Columbia River and in upland game bird and waterfowl samples in the Hanford environs; concentration of radionuclides in oysters from Willapa Bay in Washington; concentration of ^{131}I in air of the Hanford environs and concentration of radioactive particulates in the air of the pacific northwest; concentration of radionuclides in milk, hay and pasture grasses and in locally grown or purchased meats, fruits, vegetables, chickens, and eggs; ^{131}I content of beef thyroid from local cattle; ionization chamber measurements for the Hanford reservation, the Richland area, and in the Columbia River; and the chemical characteristics of Columbia River water at Hanford and Vernita. The radiological significance of these data is discussed in the parent report (BNWL-983). (E.R.B.)

33703 (BNWL-1019) CRITERIA USED TO ESTIMATE RADIATION DOSES RECEIVED BY PERSONS LIVING IN THE VICINITY OF HANFORD. Interim Report No. 2. Essig, T. H.; Corley, J. P. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 1969. Contract AT(45-1)-1830. 28p. Dep. CFSTI.

The rationale used in computation of radiation doses for calendar years 1965 and 1966 for selected population groups in the vicinity of Hanford is presented. Also discussed is the method used to compute environmental radiation doses, including the assumed dietary and living habits and the use of measured concentrations of radionuclides in several environmental media. This discussion furnishes background material for the annual environmental surveillance reports, BNWL-316 for 1965 and BNWL-439 for 1966. (auth)

33704 (CLOR/IO-70) EXPOSURE EVALUATION OF PERSONNEL DEALING WITH CLINICAL RADIUM APPLICATORS. Musialowicz, T.; Wysopolski, J. (Centralne Laboratorium Ochrony Radiologicznej, Warsaw (Poland)); Dworakowski, M.; Lobodziec, W. (Instytut Onkologii, Warsaw (Poland)). 1968. 38p. Dep.

The results of dose measurements and the evaluation of an exposure of the personnel handling medical radium applicators at the Institutes of Oncology in Warsaw and Gliwice are reported. For measurements the photographic method was chosen. Doses were simultaneously measured for six points of the body: on the head, chest, ring fingers, and gonads. For nurses, while preparing radium applicators, exposure doses were additionally measured on the finger bulbs. The differences in doses received by the particular parts of the body are very high. The doses measured on the chest, depending on the duration and the kind of procedure, amounted from less than 1 mR to 11 mR, and their corresponding doses on outer sides of the ring fingers ranged from 4 mR to 450 mR and on the finger bulbs from 40 mR to 6700 mR. It is concluded that changing the kind of applicators and using some additional shielding facilities would decrease this exposure considerably. (auth)

33705 (KY-582) ENVIRONMENTAL MONITORING SUMMARY FOR THE PADUCAH PLANT FOR 1967 AND 1968. Davis, K. A.; Brown, E. G. (Paducah Gaseous Diffusion Plant, Ky.). May 9, 1969. 12p. Dep. CFSTI.

Outdoor monitoring of air, water and vegetation in the vicinity of the Paducah Plant is summarized for the years of 1967-1968. (auth)

33706 (ORNL-TM-2574) DOSE RATES IN A SLAB PHANTOM FROM MONOENERGETIC GAMMA RAYS. Claiborne, H. C.; Trubey, D. K. (Oak Ridge National Lab., Tenn.). Apr. 28, 1969. 27p. Dep. CFSTI.

Gamma-ray flux-to-dose conversion factors obtained with a philosophy consistent with that used for neutron conversion factors have not been available for use in design work. To eliminate this inconsistency and develop more realistic γ-ray conversion factors, γ-ray dose rate distributions were determined in a slab phantom of a standard man composition. Calculations were made with the discrete ordinates code ANISN with some checks by the Monte Carlo code OGRE. Based on these results, a recommended curve to convert γ-ray flux to maximum dose rate delivered to a body was prepared for design use. It was also recommended that a new unit, the maximum exposure dose (MED) be used in shield design work to express the product of the flux, dose-rate conversion factor, and quality factor for both γ rays and neutrons. (auth)

33707 (ORNL-tr-2141) GAMMA-SPECTROMETRY RESEARCH IN HUMAN AND ANIMAL ORGANS. Lanzola, E.; Petrozzi, E.; Spina, C. Translated for Oak Ridge National Lab., Tenn., from Nuovi Ann. Ig. Microbiol., 15: 395-409(1964). 16p. Dep. CFSTI.

After consideration of the literature concerning radionuclides from fall-out in lungs and other human organs, research results (graphically illustrated) of gamma-spectrometry of lung, trachea, liver, spleen, kidney, testicle and blood of cattle and of lung and liver of human subjects of different ages are discussed. Each graph shows two grids: one, called writing grid orthogonals guiding lines, for rating down the figures subtracted, of the background, as they are read on the multichannel; the other one, which is called reading grid with curved guiding lines for reading the gamma emissions per second at a fixed energy shown by the height of each peak. In fact when the resolution of the analyzer is constant and the all-electronic chain is stable there is a precise relation between the area of a peak and its height so that the activity in the different peaks may be read from the height instead of the area. Appreciable amounts of $^{95}Zr + ^{95}Nb$ have been found in the testicles as well as in the spleen and in the kidneys of cows; twice as much ^{137}Cs has been found in the spleen as in the liver. It is noteworthy that the amount of ^{137}Cs in the liver of human subjects perfectly agrees with the figures referred to in the whole body measured with human body counter from other laboratories in the same period of time. (auth)

33708 (PHS-PUBL.-1809, pp 21-44) RADIATION PHYSICS LABORATORY. Youmans, Harry D. (Bureau of Radiological Health, Rockville, Md.).

The Radiation Physics Laboratory provides the RB-E Program with irradiation, dosimetry, and related supportive services and also conducts research studies with primary emphasis on dosimetry; these services are briefly described. Brief summaries are presented of the following research projects: doses in the brain, eye, and thyroid of children from 63 to 112 kVp x-ray epilation for tinea capitis (ring worm), spectral transmission and attenuation of x radiation by glasses and resins used in color television picture tubes; dosimetry and narrow beam irradiation of young rat thyroid; dose rate determination in bone using LiF thin discs and microrods; shielding properties of lead-impregnated rubber gloves; background γ spectrometry in North Carolina; and lipid analysis of beagles exposed to x radiation. (C.O.)

33709 DIRECT AND INDIRECT METHODS FOR ESTIMATING THE DOSE BURDEN DUE TO THE INCORPORATION OF ^{90}Sr. Malykhin, V. M.; Shamov, V. P.; Safronov, E. I. Gig. Sanit., No. 3, 58-62(Mar. 1969). (In Russian).

Studies were carried out to determine the time period, at which the dose resulting from a given amount of incorporated ^{90}Sr may be determined by direct or indirect methods. The results revealed that the usual direct technique, e.g., determination by a large scintillation-crystal spectrometer of the dose from a single incorporation of 11 to 22 μCi of ^{90}Sr, leads to values of 18 to 35 rad after four years and 68 to 140 rad after 30 years. For repeated incorporation of this isotope the residence time and accumulation of the burden within the body must be taken into account. In such cases the indirect method was found to be more sensitive. A closer study of the methods should take into account also the uneven distribution of the ^{90}Sr in the body, changes in the metabolic parameters, and elimination rates. If large amounts of the specimen are available, e.g., the total for three or four days, the indirect method is better; it is feasible for the determination not only of amounts which cause dose rates of importance from the point of view of health physics, but also for much lower amounts. (TTT)

33710 RADIOLOGICAL HEALTH DATA. Radiol. Health Data Rep., 10: 139-83(Apr. 1969).

Data from the radiological surveillance activities of monitoring networks for milk, food, water, air, and fallout deposition in North, Central, and South America are presented in tabular and graphic forms. All data are the results of the analysis of samples obtained from selected sites in the respective networks. The milk surveillance network provided data on the ^{137}Cs, ^{131}I, and ^{90}Sr content of milk in North, Central, and South America during 1968, and the ^{140}Ba and ^{89}Sr content of milk in the United States and Central America during December 1968. Data from the food and diet surveillance networks include the Ca, K, ^{137}Cs, ^{226}Ra, and ^{90}Sr content of children's institutional diets in the United States during July to September 1968, and the average dietary consumption and ^{90}Sr intake in Chicago, New York City, and San Francisco during February to June 1968. Data from water monitoring activities in the United States include the gross α and β radioactivity in raw surface waters during October 1968, the gross β radioactivity and content of ^{89}Sr, ^{90}Sr, and tritium in raw surface waters of New York during January to June 1968, and the ^{90}Sr content of tap water in New York City during January to June 1968. Data from the air and deposition activities of the Radiation Alert Network include the gross β radioactivity in surface air and precipitation in the United States during December

1968 and monthly and annual averages for 1962 through 1968. Data from the Canadian and Pan American air surveillance networks indicate the gross β radioactivity in surface air and precipitation in Canada and in surface air in Pan America during December 1968. The gross β radioactivity in airborne particulates in Mexico during July and August 1968 are also presented. Special reports are included presenting data on environmental radioactivity following Project Schooner, the ^{90}Sr content of human bones in the United States during January to March 1968, the ^{131}I content of bovine thyroid in the United States during October to December 1968, and the environmental radioactivity levels at the Feed Materials Production Center in Ohio during January to June 1968. The USAEC announces two underground nuclear tests at the Nevada Test Site during March 1969, and the detection of one underground nuclear test in the Soviet Union during the same month. (E.R.B.)

33711 ARE DOSE RECORDS AND MEDICAL SUPERVISION NECESSARY FOR LOW LEVEL RADIATION EXPOSURES? Oliver, R. (University Radiation Protection Office, Oxford). Brit. J. Radiol., 42: 397(May 1969).

The necessity for maintaining radiation dose records and special medical supervision for non-radiation personnel who are exposed to radiation levels consistently below the annual permitted dose for non-radiation personnel is questioned. The requirements as they now stand are considered to be overemphasized and unnecessary. Keeping dose records on individuals who never exceed the permissible dose is considered a waste of time and space, and the provision for special medical examination under the same conditions is thought to be an unnecessary expense and an inconvenience to busy medical personnel. (E.R.B.)

33712 THE EFFECTIVE ATOMIC NUMBER AND THE CALCULATION OF THE COMPOSITION OF PHANTOM MATERIALS. Weber, J.; van den Berge, D. J. (Reactor Inst., Delft, Netherlands). Brit. J. Radiol., 42: 378-83(May 1969).

The formula for photoelectric absorption given by Walter (1926), and used by Spiers (1946) for the calculation of an effective atomic number of a compound material, is adjusted to the values of the attenuation coefficients given by Grodstein (1957). The exponent of the atomic number has to be changed from 2.94 to 3.4 or higher. The coherent scattering is less dependent on the atomic number and is proportional to $Z^{1.7}$. A description is given of a method of calculating a phantom material which takes both effects into account. Some measurements of mass attenuation coefficients of water and of a water equivalent material composed of boron oxide, paraffin, and magnesium carbonate, indicate the accuracy of the formulae, which is about 5%. (auth)

33713 THE ^{60}Co DEPTH DOSES AND BACK-SCATTER FACTOR DATA IN THE BRITISH JOURNAL OF RADIOLOGY, SUPPLEMENT NO. 10. Tsien, K. C. (Temple Univ., Philadelphia). Brit. J. Radiol., 42: 397(May 1969).

The source of the variations in the percentage depth doses obtained using different makes and models of teletherapy radioactive source units is discussed. It is suggested that the source of the differences lies in the variations in the spectra of the radiation emitted by the sources concerned. The variations in the spectra of the sources (^{60}Co) are due in part to the higher specific activity of recently developed sources, and to the radical changes in the construction of the capsule in which the source is contained. Both of these factors affect the self-absorption and scattering within the source and hence the spectrum of the beam. The relevancy of these findings on the values given on Depth Dose Tables is discussed. (E.R.B.)

33714 RADIATION DOSES IN THE HANDLING OF SHORT-LIVED RADIONUCLIDES. McEwan, A. C. (Cambridge Univ., Eng.). Brit. J. Radiol., 42: 396(May 1969).

The radiation dose and dose-rate to the fingertips of technicians during the preparation, sterilization, and injection of the short-lived radioisotopes ^{113m}In, ^{132}I, ^{87m}Sr, and ^{99m}Tc were determined. Using LiF-teflon dosimeters, the effects of a 1.5 cm perspex and a 1.5 cm perspex + 2 mm lead shield were determined on the dose-rates from these radioisotopes in the surface of the syringes. It was found that except for the relatively low energy γ rays of ^{99m}Tc, the only dose reduction observed was due to distance. The results are discussed in terms of maximum permissible doses for occupational exposure of the hands. (E.R.B.)

33715 A FLEXIBLE FIBER OPTICS SCINTILLATION PROBE FOR INTRACAVITARY DOSIMETRY. Byfield, John; Chan, Paul; Morgan, J. E. (Univ. of California, Los Angeles). Radiology, 92: 1120-3(Apr. 1969).

Accurate intracavitary dosimetry for radiotherapy has always been hindered by the inflexibility of the probe resulting in mechanical displacement of surrounding organs. A flexible fiber optics probe was developed that greatly improves intracavitary dosimetry under conditions where configurational changes are constantly occurring in organs surrounding the site of radiotherapy. Although originally designed for use with intracavitary radium therapy, the probe demonstrates excellent accuracy with ^{60}Co teletherapy and megavoltage x-radiotherapy also. The probe is adaptable for oral, nasal, and esophageal application as well as rectal, vaginal, and urethral insertion. (E.R.B.)

33716 DOSIMETRY OF IRREGULARLY SHAPED RADIATION THERAPY FIELDS. PART II. ISODOSE CONTOURS OBTAINED UTILIZING A SIMULATED HUMAN THORAX. Anderson, R. E.; D'Angio, G. J.; Khan, Faiz M. (Univ. of Minnesota, Minneapolis). Radiology, 92: 1097-1104(Apr. 1969).

Dosimetric data for the mantle field using a phantom simulating the normal human thorax are presented. Geometric factors contributing to the penumbra of the lung shields placed in the ^{60}Co teletherapy beam were first reduced to a practical minimum. Considerable inhomogeneity in dose was found within the field in areas commonly involved in patients with Hodgkin's disease. The values ranged from 82 to 136% of the dose at the central mediastinal reference point. Some implications for clinical radiotherapy are briefly discussed. (auth)

33717 DOSIMETRY OF IRREGULARLY SHAPED RADIATION THERAPY FIELDS. PART I. SOME FACTORS INFLUENCING INHOMOGENEITY. Anderson, R. E.; D'Angio, G. J.; Khan, Faiz M. (Univ. of Minnesota, Minneapolis). Radiology, 92: 1092-6(Apr. 1969).

Factors contributing to the inhomogeneity of dose when ^{60}Co teletherapy techniques were employed to irradiate a large, irregularly shaped field were studied. Considerable improvement was obtained in the zone along the perimeter of lung shields when the block-to-skin distance was reduced from 40 to 8 cm. The resulting increase in electron contamination was eliminated for practical purposes by introducing a sheet of tin—an electron filter—as the last absorber between the ^{60}Co source and the skin. (auth)

33718 PREDICTING RADIATION DOSE EQUIVALENTS FOR POPULATIONS. II. RESULTS OBTAINED WITH THE DOSE MODELS. Kaye, Stephen V.; Rohwer, Paul S. (Oak Ridge National Lab., Tenn.). Contract AT(26-1)-171. Bioscience, 19: 326-30(1969).

This is the second part of a radiological-safety feasibility study conducted to determine the effects of the nuclear excavation of a sea level canal on the surrounding populations. Those elements whose radionuclides may contribute the most significant dose equivalent (Rem) to man are listed in order of decreasing importance and in terms of immediate or long-term hazard, mode of contamination (ingestion or inhalation), and solubility. The potential dose for the radionuclides of each element was estimated for each mode of exposure. Using tritium as an example, the influence of age-dependent parameters on the population estimates of dose equivalents is determined. After estimating the radiation dose received by various segments (age groups) of the population, the estimates were compared with appropriate radiation safety guidelines to determine whether or not they fall within acceptable limits. Several factors prevent a truly accurate feasibility study including the paucity of data on the movement of radionuclides in the environment and the lack of information on the biological parameters characterizing the exposures of indigenous populations such that realistic dose estimates can be made. (E.R.B.)

33719 DOSE IN SKELETON AND BONE MARROW FOLLOWING THOROTRAST INJECTION INTO BLOOD. Kaul, A. (Max-Planck-Inst. for Biophysics, Frankfurt am Main). Isotopenpraxis, 5: 54-9(Feb. 1969).

The calculation of the dose rate and cumulative dose in the marrow-free skeleton and bone marrow of Thorotrast patients presupposes the knowledge of both the translocation of thorium daughters to the skeleton, and the portion of ^{232}Th that is localized in colloidal form in the bone marrow. Whereas in bone marrow ^{228}Th is in equilibrium with ^{232}Th up to only 20%, in marrow-free skeleton ^{228}Th is present in excess to ^{232}Th (average activity ratio 1·75). Considering the measured activity ratios between ^{232}Th and its daughters as well as the distribution of the colloid and the nuclides of the thorium decay chain within the organism, the dose rate and cumulative dose in bone marrow and marrow-free bone were calculated as a function of the time of Thorotrast burden and the amount of injected material. (auth)

33720 THE AMOUNT OF ^{90}Sr IN THE BONES OF LEUKEMIA PATIENTS AND MEDICAL EXPOSURE THEY RECEIVED. Sato, Chikako (Tohoku Univ., Sendai); Hashizume, Tadashi. Nippon Igaku Hoshasen Gakkai Zasshi, 27: 1592-5(Mar. 1968). (In Japanese).

Analysis of Sr and measurements of its radioactivity were made on bones of 43 leukemia patients on whom autopsies were held between 1962 and 1965 at the Department of Pathology, Tohoku University School of Medicine. The relation between the activity of ^{90}Sr and the age at death is illustrated. Medical exposures that patients received before the onset of leukemia are summarized in a table. The amounts of ^{90}Sr bone were 3.17 ± 2.69 $\mu\mu$Ci/gCa (younger than 20 years) and 0.47 ± 0.31 $\mu\mu$Ci/gCa (older than 20 years). These values are not significantly different from that of normal persons in Japan. Total marrow dose by ^{90}Sr in bone and medical exposure is estimated to be 52.8 mrad per year. (NSA of Japan) (TSS)

33721 GAMMA-RAY DOSE MEASUREMENTS WITH FLUOROGLASS DOSIMETER. PART 1. PHYSICAL ASPECTS AND TECHNIQUE OF MEASUREMENTS. Kawashima, Katsuhiro; Sato, Sadao (Gunma Univ., Japan). Kitakanto Igaku, 17: 28-34(Jan. 1967). (In Japanese).

A miniature fluoroglass dosimeter was recently described as a useful and a reliable radiation detector for a variety of clinical dosimetry problems, especially in vivo dosimetry. Its use is based upon the principle of radiophotoluminescence. Previous to the glass rod dosimetry, the out put of ^{60}Co teletherapy units was calibrated using a home-made parallel plate ionization chamber with a vibrating reed electrometer. The glass rod employed is 1 mm in diameter and 6 mm in overall length. Some physical characteristics on the dosimeter with respect to the linearity between dose and fluorescence, the fading of fluorescence by the rod, and the fatigue of a photomultiplier tube and uv lamp etc., are examined to determine a reliable method for measurements with glass dosimeter. Gamma-ray dose from ^{60}Co teletherapy units over the total dose ranges of 100 to 800 R and of 1,000 to 10,000 R is measured with the glass dosimeter. Ninety-five per cent confidence intervals of the mean of population will be estimated 124 to 128 μA for 100 R exposure and 608 to 628 μA for 500 R. Ninety-five per cent confidence intervals of the coefficients of variation will be estimated $3.8\% > \mu > 1.8\%$ for 100 R exposure and $4.6 > \mu > 2.1\%$ for 500 R. (NSA of Japan)

33722 DOSIMETRY OF ^{113m}In. French, Rosemary J.; Johnson, P. F.; Trott, N. G. (Inst. of Cancer Research, Sutton, Eng. Royal Marsden Hospital, Sutton, Eng.). pp 843-62 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol. 1); CONF-680804-Vol. 1.

It is probable that ^{113m}In will become a valuable scanning agent in the future, in view of the long half-life of the parent radionuclide, ^{113}Sn, the mode of decay through electron capture with the emission of a single γ ray of energy 0.39 MeV, and the relative ease with which different chemical forms of indium can be prepared for investigations of various organs. However, at present physical data on the mode of decay and biological data on the turnover of the radionuclide in different chemical forms are comparatively sparse. In particular, since published values of the internal conversion coefficient e/γ vary from 0.35 to 0.55, both the assay of samples and calculations of dose for given biological parameters are subject to considerable uncertainty. We used $4\pi\beta$ and γ counting, and γ ionization methods to determine the internal conversion coefficient, α, and the specific γ-ray emission Γ, and to calibrate secondary standard systems. The values obtained are $\alpha = 0.53$ and $\Gamma\ (\gamma + x) = 1.78\ cm^2 \cdot R/mCi \cdot h$. A comparatively simple method for preparing an ^{113m}In colloid suitable for liver scanning was used, and the distribution of this preparation in experimental animals was investigated. Similar studies were made of the distribution of ^{113}Sn, as this exists as a contaminant in the ^{113m}In. Measurements were carried out on patients receiving ^{113m}In for liver scanning, and values for the rate of uptake of colloid by the liver, clearance from the blood, and long-term retention of ^{113}Sn in the whole body were obtained. The doses to various organs from ^{113m}In and $^{113}Sn/^{113m}In$, administered as colloid, were calculated and compared with those received from ^{198}Au and ^{99m}Tc colloids. A preliminary assessment of the merits of ^{113m}In for scanning is made. (auth)

33723 AREA SCANNING FOR QUANTITATIVE MEASUREMENT OF RADIOACTIVITY IN INTERNAL ORGANS. Arimizu, N. (Chiba Univ., Japan); Kakehi, H.; Morris, A. C. Jr. pp 653-63 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

Scanning can supply information for the quantitative measurement of radionuclides deposited in internal organs. This fact was demonstrated by many scan experiments on plexiglass phantoms containing solutions of radionuclides of medical interest. The radioactivity was measured by counting the dots on the scan records. If counts were summed over a selected portion of the scan record, they depended on the depth of the source but not on its size. The average of the counts measured from opposite directions, for instance from supine and prone, depended less on the depth of the source than on the thickness of the water phantom containing the source. These results were confirmed by measurements on sources of non-uniform activity and on the organ in a human-sized manikin. This study suggests that by using radioisotope scanners of moving-detector systems or stationary-detector systems it is possible to quantitate the activity of organs, in addition to the thyroid gland, when the scan counts are summed and averaged over a selected area, and corrections are applied for nearby activity. (auth)

33724 ANALYSIS OF RADIATION DEPTH DOSE DATA. Glover, John Richard. Rochester, N. Y., Univ. of Rochester, 1968. 189p.

Thesis.

Depth dose data from the British Journal of Radiology, Supplement Number 10, 1961, were analyzed to rectify the fact that in the seventy-two years since the discovery of x rays no single analytic method of computing central axis percent depth dose (Pc) had been produced which had been shown to be applicable over all depths (t) from the point of maximum ionization (t_o) ($T = t - t_o$), all surface field areas (A_o), and which would apply over the entire range of focal-skin distances (FSD) and qualities of interest in radiological physics. Two systems of equations were empirically derived which allow computation of Pc continuously for all depths and areas. An equation for the scatter contribution to central axis percent depth dose was also derived and can be used in an implementation of Clarkson's scheme for the calculation of off-axis depth dose and thus isodose curves. Two equations for tissue/air ratios (TAR) were derived. Evidence is presented that suggests that the equation for Pc may also apply to neutron-induced depth dose and that one equation may apply to transverse depth dose and to the description of the energy degradation of beams of radiation traversing absorbing media. (TSS) (Disser. Abstr.)

33725 CALCULATION OF DEPTH DOSES IN THE TISSUE BY THE METHOD OF STATISTICAL TESTS IN IRRADIATION WITH A WIDE BEAM OF NEUTRONS. Ivanov, V. N.; Ryabukhin, Yu. S.; Parfenov, E. N.; Ignat'ev, U. V. (Inst. of Medical Radiology, Moscow). Med. Radiol., 14: No. 3, 47-50(Mar. 1969). (In Russian).

In connection with the inadequacy of pertinent literature data for the solution of tasks of neutron treatment, calculations are presented of the distribution of depth absorbed doses of monoenergetic neutrons in a layer of tissue. The data derived may be employed for solving tasks of the therapeutic use of neutron radiation and in intratissular dosimetry. (auth)

33726 ROLE AND POSSIBILITIES OF USING ELECTRONIC COMPUTERS IN CLINICAL DOSIMETRY. Krongauz, A. N. (Moscow Scientific-Research Roentgen-Radiological Inst.). Med. Radiol., 14: No. 3, 4-7(Mar. 1969). (In Russian).

Dosimetric preparation for x radiation therapy with due consideration of individual peculiarities of the patient is a very complicated task. The choice of optimal conditions of irradiation, ensuring the correspondence of the dose field to that set by clinicians is practically impossible by manual selection. For this purpose use could be made of specialized computers. The study of volumetric distribution of absorbed radiation energy and microdosimetry at cellular and molecular levels is discussed. (auth)

33727 DERIVATION OF ISODOSE CHARTS FOR RADIUM TUBES. Buchan, R. C. T.; Griffin, Thalia C. (Plymouth General Hospital, Eng.). Brit. J. Radiol., 42: 313-15(Apr. 1969).

The methodology used in the preparation of new isodose charts for radium γ-ray sources such as are used in gynecological therapy (types E1, Er, and G2 radium tubes) is presented; the type G2 chart is illustrated. Since tubes of types E2 and E3 are geometrically similar to type E4, and E4 chart could be used for the E2 and E3 tubes by applying multiplying factors of 0.25 and 0.5, respectively. Similarly the G2 chart could be used for types G1, G3, G4, G5, and G6 by applying multiplying factors 0.5, 1.5, 2.0, 2.5, and 5.0, respectively. Copies of the new charts are available at a nominal charge from the IAEA, Division of Life Sciences, Kärntner Ring 11, A-1010, Vienna, Austria. (C.O.)

33728 THE FAST NEUTRON BEAM FROM THE M.R.C. CYCLOTRON. Bewley, D. K.; Parnell, C. J. (Hammersmith Hospital, London). Brit. J. Radiol., 42: 281-8(Apr. 1969).

A beam of fast neutrons, of mean energy about 6 MeV, has been

in use for radiotherapy since August 1966. Patients are treated in a room next to the cyclotron chamber, the beryllium target being located in the wall separating the two rooms. Treatments are given at 120 cm FSD, and at this distance the average dose-rate is about 50 rads/minute. A set of wooden collimators, which are easily changed by hand, gives a variety of field sizes up to 20 × 20 cm. A protective cone around the collimator reduces the stray radiation to an acceptable level. Depth dose characteristics are intermediate between those of the 200 kVp x rays and ^{60}Co γ rays. The dose from γ radiation amounts only to a few percent of the dose from fast neutrons and has been measured with photographic films and thermoluminescent dosimeters. Thermal and epithermal neutrons make only small contributions to the absorbed dose. The beam has been developed sufficiently for a clinical trial to be made. The penetration of the beam is adequate for the radiotherapy of all but the deepest lying lesions. (auth)

Radiation Protection

Refer also to abstracts 33714, 33839, and 33903.

33729 RADIATION HAZARDS TO THE HUMAN FETUS. Scoville, Addison B. Jr. J. Tenn. Med. Ass., 61: 1016-17 (Oct. 1968).

Possible effects of in utero radiation exposure are briefly reviewed. Considerable evidence has accumulated that indicates the radiosensitivity of the recently fertilized egg is greatest in the gastrula and morula stages and it decreases gradually during fetal life. The radiosensitivity of the mouse embryo in utero depends on the day of gestation with the LD_{50} rising from 100 R after fertilization to 800 R at birth. If less than 100 R can be lethal in the earliest stage of pregnancy, at a time when pregnancy is not usually recognized, a much smaller dose will damage the fetus in some other way, but will let it survive in an abnormal state. Attempts to answer two questions are considered, namely, what is the smallest dose that can harm the fetus and what is the largest dose that a human fetus receives from diagnostic medical radiography? Whether gonadal doses between one and 10 R delivered to a pregnant woman can harm the baby is discussed. Various studies suggest that the first rule for the practicing physician should be to refrain from diagnostic x-ray procedures other than filming the chest during pregnancy unless such procedures are absolutely necessary. Usually a cholecystogram, pyelogram, lumbosacral spine, or intestinal study can wait until after delivery. (BBB)

33730 NUCLEAR SCIENCE AND TECHNOLOGY IN THE GDR. Kernenergie, 12: 28-34(Jan. 1969). (In German).

The Federal Office for Radiation Protection has the responsibility for: carrying out or initiating necessary research and development; training technicians in radiation protection; establishing the area and type of radiation controls; and implementing radiation protection procedures wherever ionizing radiation is present. The legislation under which this organization operates is briefly summarized. The monitoring procedures and the dosimeters used are outlined. The research and development sponsored by the organization with respect to monitoring, radioactive wastes, protection techniques, and incorporation are discussed. (J.S.R.)

33731 REDUCTION OF PATIENT DOSE IN X-RAY FLUOROSCOPY AND RADIOGRAPHY. 3rd REPORT. EXTRA-EXPOSURE TO THE PATIENT BY X-RAY EXAMINATION. Koga, Sukehiko (Nagoya Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 27: 1387-91(Jan. 1968). (In Japanese).

The amount of medical x-ray films used for medical purposes in Japan during the period of 1966 was estimated at 671×10^4 m^2 which was about four times that used in 1956. Repeated examination due to failure causes the extraexposure to the patient. It was about two percent of total film radiographed at five large hospitals in Aichi prefecture. The reasons for re-examinations were technical errors of the radiographers in 42.4 to 48.3 percent; trouble with the x-ray machine in 18.5 to 26.5 percent; patient side failure in 15.5 to 30.1 percent and other reasons in 9.0 to 9.7 percent. Multileaf diaphragms for the x-ray beam limitation were installed in only sixty-six percent at the hospitals above mentioned. Maintenance of the diaphragm for correct beam limitation to the film was bad in eighty percent of the hospitals. Leakage of radiation dose from diagnostic x-ray tube housing was low enough not to exceed the limit provided in the law. (TSS) (NSA of Japan)

33732 CUMULATIVE RADIATION DOSE RECORDS. Davison, M.; Harrison, N. T. Brit. J. Radiol., 42: 319(Apr. 1969).

Suggestions for improvements in the practices and recommendations made in the Code of Practice for the Protection of Persons Against Ionizing Radiations Arising from Medical and Dental Use are presented and discussed. It was suggested that implementation of the recommended changes would result in highlighting the significant radiation exposures that are received by about 2% of the staff and eliminate the large amount of work involved with the remaining 98%; in addition, more accurate records would be provided which also might be of scientific interest at some future date. It was concluded that the present system had very little to commend it. (C.O.)

Safety Procedures

33733 EVALUATION OF ACCIDENTS RELATED TO THE USE OF SEALED RADIATION SOURCES FROM THE VIEWPOINT OF MEDICAL DOSIMETRY. Vershinin, N. V.; Terman, A. V. Gig. Sanit., No. 3, 55-8(Mar. 1969). (In Russian).

The term radiation accident is used to designate a situation resulting in the exposure of persons to external or internal irradiation, or in the radioactive contamination of the land or object at a level higher than the established standards. Lack of working experience with sealed sources is a frequent cause of such accidents. A case history involving the accidental exposure of auxiliary personnel involved in inventory taking of sources at a hospital is reviewed. It was attempted to reconstruct the geometric relations which prevailed between the source and the victims during the exposure, in order to calculate the absorbed dose. It was found that in spite of the high local dose, the whole-body exposure was negligible; this checked with the clinical observations. It was emphasized that small high-activity sources must be handled with special care because they present a great potential hazard, especially to the hands and wrists. Containers of radioisotopic sources must carry the usual warning sign. (TTT)

33734 DESCRIPTION OF A DOSIMETRIC SYSTEM USING FILM-BADGES FOR THE PROTECTION OF PERSONNEL IN THE MEDICAL FIELD. Belletti, Sergio (Spedali Civili Brescia, Italy). Radiol. Med., 55: 361-70(Apr. 1969). (In Italian).

A method for personnel dosimetry with film badges is described; it is based on the differential filtration system; 0.1, 0.5 and 1 mm copper filters and a 1 mm lead filter are used. The curves of blackening and transmission in copper characteristic of the films and of the radiation beams used in calibration are given. The method described may serve as an example for the radiation protection of personnel in a large hospital. (auth)

33735 POTENTIAL HAZARDS OF MICROWAVE OVENS. Ely, Thomas S. (Eastman Kodak Co., Rochester, N. Y.). J. Occup. Med., 11: 202(Apr. 1969).

The safety of microwave ovens is explored in answer to a question from an industrial physician. Standards for safe exposure levels to microwaves are discussed. It is suggested that these ovens be subject to a routine program of industrial hygiene monitoring. (M.M.B.)

Civil Defense

Refer to abstract 33536.

Legal Aspects

Refer also to abstract 33730.

33736 (CONF-670649-12) SPECIFICATIONS AND NORMS OF RADIOPHARMACEUTICALS. del Val Cob, Manuel; Rebollo Garrido, Daria Victoria; Casas Medina, Francisco de Asis (Junta de Energia Nuclear, Madrid (Spain)); Radicella, R.; Recchi, N. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Gerencia de Energia). [1966]. 86p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

The radiopharmaceuticals, or radioactive compounds administered to patients for diagnostic or therapeutic purposes, have a series of physical, chemical, and biological characteristics which permit their use in humans. The norms and specifications for different radiopharmaceuticals of ^{198}Au, ^{82}Br, ^{51}Cr, ^{64}Cu, ^{203}Hg, ^{131}I, ^{32}P, and ^{99m}Tc are established. These are reported in different chapters on each radioisotope. (tr-auth)

33737 CURRENT STATUS OF THE DANGERS OF IRRADIATION. Greenfield, M. A. Acta Iber. Radiol.-Cancerol., 21: 267-73(July-Sept. 1966). (In Spanish).

The present recommendations of the International Commission on Radiological Protection are summarized. The radiation burden estimated for the average man because of cosmic radiation, natural radioactivity, radiotherapy, and radiodiagnosis is given. The consequences of surpassing the official recommendations are briefly discussed. The precautions that can be taken to give a reasonable protection from the dangers of excessive exposure are considered briefly. (J.S.R.)

Medicine

33738 LEUKEMIA IN ANIMALS AND MAN. Proceedings of the 3rd International Symposium on Comparative Leukemia Research, Paris, July 12–13, 1967. Bendixen, H. J. (ed.). Bibliotheca Haematologica No. 30. Basel, S. Karger AG, 1968. 358p. (CONF-670732).

Seven lectures and 72 short communications were included in the symposium. Areas of interest were interactions between cells and oncogenic viruses; advances in research on leukemogenic viruses; etiologic studies of bovine leukosis; epidemiology, pathology, and diagnosis of bovine leukosis; porcine, canine, and feline leukemia; and progress in human leukemia research. Four short communications within the scope of NSA were abstracted separately. (C.O.)

For abstracts of individual papers see: 33655, 33849, 33850, and 33910.

Protective Substances

Refer also to abstracts 33649, 33660, 33865, 33877, 33892, 33905, and 33915.

33739 INTERNAL RADIOPROTECTION AND ELECTRON DELOCALIZATION. Lion, Yves; van de Vorst, Albert. Bull. Cl. Sci., Acad. Roy. Belg., 54: 1324-31(1968). (In French).

Electron conjugation is proven to be a dominant factor in determining the amount of protection for internal radioprotection phenomena for a class of compounds formed from the same aliphatic entity and aromatic constituents. Thus in the naphthylglycine, phenylglycine, and biphenylglycine series except in the ribonucleosides derived from purine bases, one observes a satisfactory parallelism between the resonance energy of the electron-π of the aromatic constituent and the amount of protection of the aliphatic compounds. (tr-auth)

33740 COMPARISON OF THE RADIOPROTECTIVE EFFECTS OF CYSTAMINE AND CYSTEAMINE ON THE SKIN. Van Caneghem, Pierre (Univ., Liege). Strahlentherapie, 137: 231-7(Feb. 1969). (In German).

Differences of radiation protection between cystamine and cysteamine on skin were investigated with respect to the mode of application. Local injection of cystamine into the skin had no protective effect because it could not be reduced to cysteamine; if it was injected intraperitoneally, however, it was more active because its pharmacological effects (hypotension, shock, anoxia) were stronger than those of cysteamine. (H.B.G.)

33741 CONTEMPORARY VIEWS ON THE USE OF RADIOPROTECTIVE AGENTS. Dostal, M. (Purkyne Military Inst. for Research and Postgraduate Training, Hradec Kralove, Czech.). Cas. Lek. Cesk., 108: 397-404(Mar. 28, 1969). (In Czech).

Radioprotection given by aminothiocompounds (cysteamine, cystamine, AET) can extend survival after supralethal doses of irradiation as well as reducing the risk of infectious and hemorrhagic complications. Primary radiation effects are reduced and spontaneous repair facilities of the organism enhanced. Aminothiocompounds combined with tryptamine offer protection and eliminate toxic effect that would appear in individual application. (JPRS)

33742 PHARMACOLOGICAL EFFECTS OF RADIOPROTECTIVE AGENTS CYSTEAMINE, CYSTAMINE, AND AMINOETHYLISOTHIOURONIUM. Kuna, P. (Purkyne Military Research and Postgraduate Training Medical Inst., Hradec Kralove, Czech.). Cas. Lek. Cesk., 108: 404-412(Mar. 28, 1969). (In Czech).

The three agents tested possess marked radioprotective pharmacological effects. Cystamine reduces blood pressure at therapeutic dose levels, induces an increase in systolic pressure and minute heart volume, improves the utilization of oxygen in tissues, and produced other effects. The action of AET is inverse in a number of effects. (JPRS)

33743 THE EFFECT OF DIMETHYL SULFOXIDE ON THE ALLOSTERIC TRANSITIONS OF GLUTAMIC DEHYDROGENASE. Henderson, Thomas R.; Henderson, Rogene F.; Johnson, Gregory E. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Arch. Biochem. Biophys., 132: 242-8 (June 1969).

The modification of the allosteric transitions of bovine liver glutamic dehydrogenase (GDH) [L-glutamate: NAD(P) oxidoreductase (deaminating) EC 1.4.1.3] by heavy water D_2O led to the investigation of the effects of a second solvent, dimethyl sulfoxide (DMSO), on GDH. DMSO resembles D_2O in that it replaces bound water in proteins and also forms stronger hydrogen bonds than water. DMSO was found to induce or facilitate the conversion of the active monomer into the inactive monomer and to stabilize the inactive monomer against irreversible denaturation into individual subunits. DMSO decreased the ability of ADP to stimulate GDH and increased the ability of GTP to inhibit the enzyme. These results suggest that the inactive monomer of GDH may have more hydrophilic groups on the surface of the protein available for hydrogen bonding with solvents such as DMSO or D_2O and hence is favored in the presence of these solvents. The ability of the aprotic solvent DMSO to compete with the protein for proton-donor groups to form hydrogen bonds may explain the apparent dissociation of polymeric aggregates observed in the presence of low levels of DMSO. (auth)

33744 EFFECT OF HETEROLOGOUS ANTILYMPHOCYTE SERUM ON THE HOMOLOGOUS AND HETEROLOGOUS BONE MARROW TRANSPLANTATION IN SUPRALETHALLY IRRADIATED MICE. Thierfelder, S.; Moeller, D.; Kimura, I.; Doermer, P.; Eulitz, M.; Mempel, W. (Institut fuer Haematologie, Munich). Blut, 15: 225-9(July 1967). (In German).

The secondary syndrome of runt disease was studied in mice x-irradiated with a supralethal dose of 900 R and transfused with C57Bl bone marrow. The disease was delayed and sometimes suppressed by use of rabbit anti-mouse lymphocytic serum. Without antiserum the survival time of the animals in the system was 15.6 days. The survival time was increased to 27.8 days when the mice were treated with antiserum of the donor mice. When the treatment with antiserum was extended until 3 weeks after irradiation the survival time was increased to 34.8 days. The heterologous bone marrow transfusion from rat into mouse also was favorably influenced by antilymphocytic serum. (BBB)

33745 ALTERED FRACTIONATION EFFECTS IN HYPOXIC CELLS. Phillips, T. L. (Univ. of California Medical Center, San Francisco). Front. Radiat. Ther. Oncol., 3: 122-30(1968). (UCSF-10P2-39).

The LD 50/30 was determined in mice for 1, 2, 5, and 10 fractions of an x-radiation dose with mice breathing either air or 5% oxygen. In determining dose response curves the number of spleen colonies produced by transplanting 10^5 unirradiated bone marrow cells was compared to the number produced by various numbers of irradiated marrow cells, and surviving fractions were calculated. The D_{37} was 107 rads in mice breathing air and 231 rads in mice breathing 5% oxygen, yielding an oxygen enhancement ratio of 2.2. With larger doses and fewer fractions, fractionation appeared to increase the LD 50/30 in air but caused only a slight increase in the LD 50/30 obtained under hypoxic conditions. In general, dose response curves obtained in mice and in vitro for transplanted colony forming cells showed a similar D_{37} and extrapolation number both in air and under hypoxic conditions. It was concluded that multiple fractions possibly allowed euoxic cells to recover, thereby increasing the dose needed for a given degree of damage while allowing less increase in the dose required for similar changes in an hypoxic cell. (C.O.)

33746 ANOXIA IN RADIOLOGY. Chapman, J. D. (Mt. Vernon Hospital, Middlesex, Eng.); Sturrock, Jean; Boag, J. W.; Crookall, J. O. Brit. J. Radiol., 41: 951-2(Dec. 1968).

Problems involved in the complete removal of oxygen from the nutrient media in which animal cells are grown or irradiated are discussed. It is pointed out that the type of Petri dish used (glass or polystyrene) may affect results of anoxic experiments. The solubility of oxygen in polystyrene was measured and found to be about five times as high as in water. Polystyrene Petri dishes were found to contain a large store of dissolved oxygen that may affect experimental results. It is pointed out that with glass Petri dishes there are also difficulties in producing anoxia in small liquid volumes. (C.H.)

Radiation Sickness and Injuries

33747 ON THE PROBLEM OF THERAPY OF THE RADIATION SYNDROME. Hochrein, Hans; Braun, Heribert; Viering, Juergen (Medizinische Univ., Wuerzburg, Ger.). Strahlentherapie, 137: 196-203(Feb. 1969). (In German).

The effect of treatment on radiation syndrome was studied on 242 albino rats. Treatment with Ringer solution, haemaccel, and effortil did not effect survival, neither did administration of tranquilizers or hypnotics, such as pernocton or urethan. It is concluded that the treatment normalized the hematocrit, the extracellular concentration of sodium, and the intracellular potassium content of the myocardium; however, the radiation syndrome irreversibly reduced the water content, its intracellular pool, and the intracellular sodium content of the myocardium. (H.B.G.)

33748 EVALUATION AND MANAGEMENT OF RADIATION-INDUCED PERICARDIAL EFFUSION. Kagan, A. Robert; Morton, Donald L.; Hafermann, Mark D.; Johnson, Ralph E. (National Cancer Inst., Bethesda, Md.). Radiology, 92: 632-4(Mar. 1969).

Pericardial effusion is an uncommon clinical manifestation of Hodgkin's disease although recognized with some frequency postmortem. However, the occurrence of pericardial effusion after mediastinal irradiation for Hodgkin's disease is of significant frequency to merit discussion of its treatment. Seven patients whose mediastinum was irradiated through anterior fields with doses of 3,000 to 4,000 rads delivered to the mid chest in four to six weeks developed pericardial effusion. The dose to the anterior cardiac region varied from 5,000 to 7,000 rads depending on the anteroposterior diameter of the chest wall and the dose delivered to the mid chest. The diagnosis of pericardial effusion was largely based on the enlarging cardiac silhouette on the roentgenogram. Cardiac scans with ^{99}Tc albumin confirmed the diagnosis of pericardial effusion when suggested by the serial chest films. Elevated venous or right atrial pressures, dyspnea, or pulses paradoxicus appeared only after the enlarged cardiac silhouette was present for some time. In a minority of patients there were changes in the electrocardiograph. Signs of symptoms of constrictive heart disease were present in only four of the seven patients. Dyspnea and pulsus paradoxicus of over 10 mm Hg were the most common findings. Elevated right atrial and end-diastolic ventricular pressures were found in four out of five patients having cardiac catheterization. Pericardiectomy was accomplished through a left horizontal thoracotomy incision. At surgery some mild thickening (2 to 10 mm) of most of the irradiated pericardium was found in all cases, and the epicardial fat appeared dull. The pericardial fluid was straw-colored in three patients and serosanguinous in four Bacterial cultures were negative. The lactic acid dehydrogenase of the pericardial fluid was elevated in one out of the four cases tested. At pericardiectomy the pericardium was removed anteriorly to the atrioventricular groove on the right, superiorly to the base of the pulmonary artery, posterolaterally to the inferior pumonary vein, inferiorly over the diaphragm, and posteriorly to the inferior vena cava at its entrance into the atrium. A needle biopsy of the heart was obtained when feasible. Careful followup of these patients will determine whether constrictive epicarditis or cardiomyopathy will complicate their postpericardiectomy course. Nonetheless, it should be noted that acute cardiac tamponade was avoided, and pericardiectomy was completed with relative ease technically. The postoperative course has been quite satisfactory to date. (C.H.)

33749 CHAMBER BATH THERAPY WITH NAPHTHALENE EMULSIONS IN DISORDERS OF THE PERIPHERAL BLOOD CIRCULATION IN PATIENTS CHRONICALLY EXPOSED TO IONIZING RADIATION. Bragina, V. A.; Kipsanova, G. I. Gig. Tr. Prof. Zabol., 12: 43-5(Jan. 1968). (In Russian).

Combined therapy using electric currents and pharmaceuticals with naphthalene emulsion baths produced beneficial effects on regional peripheral blood circulation in patients suffering from radiation sickness. (R.V.J.)

33750 BONE MARROW TRANSPLANTATION. Balner, Hans (Radiobiological Inst. TNO, Rijswijk, Netherlands). Euro-Spectra, 8: No. 1, 21-7(Mar. 1969).

The article constitutes a very qualitative review of the present status of knowledge of bone marrow transplantation, especially in relation to use in treatment of radiation injuries, and of the work done at Rijswijk. From work with rats and mice it appears that the graft-versus-host reaction (usually fatal in man and monkeys) can be reduced by tissue typing, in vitro reduction or inactivation of the lymphoid part of the hemopoetic system, or by post-transplantation treatment with antilymphocyte serum or cytostatic drugs. Alteration of the lymphoid part of the transplant can be accomplished by centrifuging to separate cell types, by storing at various temperatures, or by incubations which selectively kill or incapacitate. Tissue typing can be done by the usual red blood cell typing or by leukocyte typing using many specific antisera with a computer program. The grafting experiments that have been done with Rhesus monkeys are described, and a table is given listing the treatment, reaction, survival time, and probable cause of death for 9 monkeys. (C.O.)

Radiodiagnosis

Refer also to abstracts 33164, 33166, 33388, 33417–33427, 33429–33470, 33549, 33591, 33618, 33719, 33723, 33729, 33800, and 33897.

33751 (CONF-670649-3) EVALUATION OF HEPATIC GAMMAGRAPHY WITH RADIOACTIVE COLLOIDAL GOLD BASED ON THE REALIZATION OF A THOUSAND EXPLORATIONS. Ortiz Berrocal, J.; Arnaiz Bueno, F.; Crespo Diez, A. (Clinica Puerta de Hierro, Madrid (Spain)). [1967]. 7p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

The morphological-topographic study of the liver by means of radioactive materials is efficient, easy, and harmless. The results obtained from more than a thousand studies made on normal subjects and patients with malignant tumors or diseases of different types are reported. A statistical evaluation was made of the results in those cases in which autopsy or surgical results were available. (tr-auth)

33752 (CONF-670649-26) CLINICAL EVALUATION OF THE ISOTOPIC RADIOCARDIOGRAPH. Gomez Lopez, Juan; Hernandez Madariaga, Rogelio; Bas Rodriguez, Jose Sergio (Hospital Regional del Aire, Madrid (Spain)). [1967]. 12p. (In Spanish). Dep.

From Symposium on Applications of Radioisotopes, Madrid, Spain.

The principles and techniques of isotopic radiocardiography are summarized. The clinical applications are outlined. Typical curves obtained are shown for illustration. (J.S.R.)

33753 (RISO-M-878) KIDNEY CONSTANT CALCULATOR. Hoejberg, K. Soee; Knudsen, E. (Danish Atomic Energy Commission, Risoe. Research Establishment). Apr. 1969. 13p. Dep.

The program is used for the determination of two constants describing the transport of hippuran to and from the kidneys on the basis of a simple kidney and external system model. The data used for the computation are derived from a renogram test. (auth) (Denmark)

33754 ROSE BENGAL LIVER AND ABDOMINAL SCANS IN THE DIFFERENTIAL DIAGNOSIS OF JAUNDICE. Davia, James E.; Earll, Jerry M.; Moore, Ronald D.; Durden, W. Dawson (Tripler Army Medical Center, Honolulu, Hawaii). Mil. Med., 134: 445-50(June 1969).

Forty-five jaundiced patients were studied with serial scans of the abdomen, after injection with radioiodinated rose bengal. Patency of the biliary tree was accurately determined in all 32 cases of non-obstructive jaundice, and in 11 of 13 cases of obstructive jaundice. This technique allows direct observation of the passage of the dye through a patent biliary system into the gut. When the biliary tree is completely obstructed, a gut pattern is not visualized. When excretion through the biliary tree is impaired, renal excretion becomes more significant, and scanning allows correct identification of radioactivity from this source by outlining the familiar renal shape. This technique is a safe and remarkably accurate means of distinguishing between complete obstructive and incomplete or non-obstructive jaundice. (auth)

33755 RESULTS OF BRAIN TUMOR DIAGNOSIS WITH ^{131}I-LABELED ALBUMIN MACROAGGREGATES. Dietz, H.; Haas, J. P.; Wolf, R. (Univ., Mainz). Radiologe, 8: 397-401 (Dec. 1968). (In German).

Brain scans were performed with iodine-131-labeled albumin macroaggregates injected into the carotic or vertebral arteries. In 75 patients subsequent scans were obtained with technetium-99m. The two radioactive materials yielded approximately the same positive results of 71% and 74%, respectively. However, a striking difference between the two procedures exists as follows: technetium-99m always is accumulated in the tumor area; iodine-131 is concentrated only by certain types of tumors, while others prevent entrance of the material and cause a cold spot. Further studies are necessary to evaluate this difference for its diagnostic importance. (H.B.G.)

33756 VALUE OF BRAIN SCANS IN SPACE OCCUPYING PROCESSES LOCATED INTRATENTORIALLY. Lincke, H. O. (Univ., Munich). Radiologe, 8: 401-6(Dec. 1968). (In German).

In 110 patients brain scans were performed after injection of mercury-203- or mercury 197-labeled chlormerodrin. Among these, space occupying lesions could be detected in 56 and surgically verified in 39 patients. Due to its simplicity, the scanning method was adopted as part of routine diagnostic procedures in suspected intratentorial lesions. (H.B.G.)

33757 HEPATIC SCINTIGRAPHY IN HODGKIN'S DISEASE. Clementi, T.; Spina, C. (Univ., Rome). Nunt. Radiol., 33: 1155-67(Sept. 1967). (In Italian).

Anatomical and pathological changes of the liver in course of Hodgkin's disease are reviewed. The diagnostic value of scanning with ^{198}Au is discussed. Scintigraphy frequently shows a moderate hepatomegaly, sometimes associated with pictures of infiltrative type, more rarely with aspects of lacunar type or compression by

large lymph node tumors. The direct involvement of the liver without moderate enlargement of the organ is rarely seen. The scintigraphic examination allows confirmation of the suspect or the clinical diagnosis of hepatic localization and often shows an otherwise not verifiable alteration; it is possible, moreover, to follow the evolution of the disease by scintigraphy. (auth)

33758 LOCALIZATION OF A MEDIASTINAL ADENOMA BY SELENOMETHIONINE ^{75}Se SCANNING. Goodwin, David A. (Veterans Administration Hospital, Palo Alto, Calif.); Crowley, Lawrence G.; Camargo, Carlos A. J. Amer. Med. Ass., 208: 2333-5(June 23, 1969).

Scanning with selenomethionine ^{75}Se revealed an ectopic parathyroid adenoma in the mediastinum of a patient with persistent hyperparathyroidism after a neck exploration in which four normal-looking parathyroid glands had been identified. (auth)

33759 A VIDEO TAPE RECORDER USED TO REDUCE PATIENT DOSE DURING X-RAY SCREENING. Docker, M.; Astley, R. (The Children's Hospital, Birmingham, Eng.). Brit. J. Radiol., 42: 358-63(May 1969).

Two systems are described that were used to reduce x-ray dosage to patients during x-ray screening of comparatively slow procedures. The first system produced short pulses of x rays, viewed directly via a television monitor; the second system used short pulses of x rays to produce a single frame recording on a video tape recorder, this being immediately replayed for up to one second. Reductions in dose by a factor of 20 were obtained with these systems. (auth)

33760 SCINTIPHOTOGRAPHY WITH GAMMA CAMERA IN THE DIAGNOSIS OF ENDOCRANIAL LESIONS. Tori, Giulio; Marabini, Alberto (Univ., Bologna. Ospedale Civile, Verona, Italy). Radiol. Med., 55: 335-44(Apr. 1969). (In Italian).

Scintiphotography with a gamma camera was used to examine about 150 patients in whom an endocranial lesion of tumoral or vascular nature was clinically suspected. It is concluded that scintiphotography with gamma cameras remarkably increases the diagnostic possibilities offered by conventional scintigraphy. (auth)

33761 THE RADIOTRIOLEIN TEST: CHECKS AND CONSIDERATIONS ON THE SIGNIFICANCE AND RELIABILITY OF RADIOHALOGENATED TRIGLYCERIDES USED IN STUDYING INTESTINAL FAT ABSORPTION. Riccardi, Armano; Martinenghi, Carlo; Bergonzi, Mario (Univ., Milan). Radiol. Med., 55: 345-60(Apr. 1969). (In Italian).

A critical review of the results previously obtained on intestinal fat absorption tests by means of radiotriolein is presented to ascertain the reliability and limits of this method. It is pointed out that the measurements of fecal radioactivity are no less influenced by intestinal dehalogenation of the tracer (apart from absorption and digestive processes). This explains the high number of false negatives. The low radiochemical purity of the labeled triglyceride accounts for an appreciable number of false positives. Furthermore, examination of the plasma radioactivity curve and of urinary excretion, after oral ingestion of a tracer quantity of radiotriolein, offers no information about the intestinal absorption of food lipids. It is concluded that labeled oleic acid does not appear capable of appreciably improving the diagnostic usefulness of labeled lipids in evaluating intestinal fat sorption. (auth)

33762 THE CORRELATION BETWEEN THE DATA FROM SPLEEN SCANNING AND ANATOMICAL EXAMINATION OF THE SPLEEN IN HODGKIN'S DISEASE. Parmentier, C.; Askienazy, S.; Gerard-Marchant, R.; Lacour, J.; Amiel, J.-L.; Lemerle, J.; Tubiana, M. (Institut Gustave-Roussy, Villejuif, France). Ann. Radiol., 12: R43-56(1969). (In French).

The abnormalities which are seen in the spleen scan in Hodgkin's disease are the presence of filling defects and heterogeneity of uptake. In the present series of 20 patients in whom spleen scanning was performed before splenectomy or examination of the spleen at autopsy, cold areas corresponding to involvement of the spleen was seen in 7 cases. Involvement of this kind can be due either to the presence of a large tumor deposit or to the occurrence of confluent micronodules of tumor. This explains why the appearance of cold areas is less uncommon than had been previously supposed. The histological forms showing diffuse fibrosis tend to produce this type of appearance more commonly than forms where there is a predominance of lymphocytes. The heterogeneity of uptake may be due either to involvement by lesions which are beyond the resolution of the scanner (5 cases), or to stasis induced by enlarged para-aortic or coeliac lymph nodes (2 cases). Such an appearance may also be due to hyperplasia of the white pulp (one case). A homogeneous appearance suggests a normal spleen but microlesions may certainly be missed on scanning. Because of the difficulties of interpretation the results of the investigation should be considered in the light of the clinical picture as a whole. Palpation of the spleen is of doubtful value. The sedimentation rate is a valuable indication of activity of the disease. The liver and spleen can be independently involved. The spleen can be involved in the absence of detectable lymphographic involvement. The presence of large involved para-aortic nodes should suggest the possibility of stasis consequent upon node compression. (auth)

33763 METHODS AND RESULTS OF LIVER SCINTIGRAPHY. Haubold, U. (Univ., Munich). Deut. Med. Wochenschr., 94: 386-8(Feb. 21, 1969). (In German).

Colloidal ^{198}Au is the most widely used material in liver scintigraphy. A brief survey is given of the types of information available from ^{198}Au scintigraphy. During the past years very short-lived radioisotopes have been used in routine diagnosis, chiefly ^{99m}Tm and ^{113m}In in colloidal form. The advantage of these short-lived isotopes is the reduction of the radiation burden to the patient. Liver-independent elimination mechanisms play an important role in the clearance of their isotopes. However, for a differentiated nuclear diagnostic liver study, radiogold is indispensable. (J.S.R.)

33764 INITIAL EVALUATION OF ^{113m}In AS AN AGENT FOR PLACENTAL BLOOD POOL IMAGING. Johnson, Philip M.; Chao, Solan; Goodwin, Paul N. (Columbia Univ., New York). Radiology, 92: 625-6(Mar. 1969).

Scintillation imaging of the placental blood pool was performed in 16 patients, by employing an acidic solution of indium-113m as the tracer. The placenta was visualized in each patient, and vertical localization was accurate in 14 of the 16. Placental transfer of the nuclide into the fetal blood was minimal. Pending the results of further investigations, indium-113m is considered a useful nuclide for placental imaging. (auth)

33765 PLACENTAL LOCALIZATION BY SCANNING WITH ^{113m}In. Huddlestun, James E.; Mishkin, Fred S.; Carter, James E.; Dubois, Philip D.; Reese, Isaac C. (Indiana Univ., Indianapolis). Radiology, 92: 587-90(Mar. 1969).

Indium-113m as indium chloride which will bind tightly to serum transferrin when injected intravenously and a dual 8-inch crystal rectilinear scanner were used for placental localization. In 41 patients with third trimester bleeding and in two undergoing aminocentesis scans were performed following injection of 4 mCi of In-113m. The placenta was correctly localized in 38 of the 41 patients. There was no difficulty in identifying the placenta in any case, but the exact relationship of the placenta to the uterine os occasionally proved difficult to interpret. Measurement of a tracer dose in a single patient showed no activity in cord blood. With a dose of 4 mCi of In-113m the mother will receive approximately 70 millirads and the fetus 30 millirads whole-body γ dose. Placental studies of superior quality are quickly and safely obtained with the use of In-113m. (auth)

33766 THROMBOPHLEBITIS: DEMONSTRATION BY SCINTISCANNING. Webber, Milo M.; Bennett, L. R.; Cragin, Michael; Webb, Roscoe Jr. (Univ. of California, Los Angeles). Contract AT(04-1)-Gen-12. Radiology, 92: 620-3(Mar. 1969).

Experimental work is reviewed that suggested the possibility of the usefulness of macroaggregates of albumin as a tracer agent capable of demonstrating thrombophlebitis. Macroaggregates of albumin tagged with ^{99m}Tc were injected upstream to points of suspected venous thrombotic disease in several patients. Accumulation of tracer which conforms to the extent and locale of the disease process was demonstrated. This confirms basic experimental work on dogs with artificially produced venous thrombotic disease. Current studies are in progress to evaluate the physical basis of localization and the clinical usefulness of the technique. (auth)

33767 PERFUSION ^{131}I MACROAGGREGATE BRAIN SCANNING: A CLINICAL EVALUATION OF ITS DIAGNOSTIC EFFICIENCY. Kanafani, Santos Briz; Constantino, Gustavo Lazos (National Inst. of Neurology, Mexico City). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 333-9(June 1969).

We have endeavored to make a clinical evaluation of perfusion scanning in a study of 50 patients with various types of intracranial pathology. Several recent articles in the medical literature have pointed to the innocuous nature of this process insofar as the presence of the microemboli is concerned. The difference inherent is this type of brain scanning and its potential importance lie in the fact that it delineates cerebral blood flow only where this is preserved. Under the most rigid conditions of safety, we injected 50 microcuries of the ^{131}I radioactive tracer into the internal carotid artery, usually under roentgenologic control, at the end of the angiographic study. The patients were seen in the National Institute of Neurology and the injection was carried out under local or general anesthesia. The radioactive substance, diluted in 5 ml of isotonic saline solution, was injected on the side corresponding to the

suspected lesion. Lateral and anteroposterior scannings were made. In the body of this paper we have discussed the generally excellent correlation between the scan and clinical findings, the variety of lesions which it can localize without, however, supplying us with data which could suggest the pathologic nature of the lesion, and finally, the added proofs that the microemboli in themselves do not damage the brain tissue. (auth)

33768 VERTEX VIEW IN ROUTINE BRAIN SCANNING. Holmes, Richard A. (Marquette Medical School, Milwaukee). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 347-53 (June 1969).

To establish the value of the vertex view in routine brain scanning, 139 abnormal pertechnetate brain scans, diagnosed from 638 studies in which the vertex projection was routinely taken along with the conventional views, were evaluated for the lesions on each individual scan. We found that the vertex view detected 89.9 per cent of the lesions; the right lateral, 41.7 per cent; left lateral, 59.7 per cent; the anterior, 69.4 per cent; and the posterior, 81.7 per cent. A variety of abnormalities was detected with the vertex view including 2 cystic lesions appearing as negative defects and basilar brain lesions. The selective nature of the properly positioned posterior view accounted for its high detection percentage. The routine use of the vertex view is recommended. (auth)

33769 THE DIAGNOSIS OF DANDY-WALKER CYST BY BRAIN SCANNING. Traicoff, Donald; Mishkin, Fred S. (Indiana Univ. Medical Center, Indianapolis). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 106: 344-6(June 1969).

A case of Dandy-Walker cyst is reported which demonstrates that it is possible to suggest the diagnosis from the brain scan. Elevation of the torcular Herophili and lateral sinuses are characteristic features of a Dandy-Walker cyst. (auth)

33770 VISUALIZATION OF HEART AND KIDNEYS IN ANIMALS WITH ULTRASHORT-LIVED ^{82}Rb AND THE POSITRON SCINTILLATION CAMERA. Yano, Yukio; Anger, Hal O. (Univ. of California, Berkeley). Contract W-7405-eng-48. J. Nucl. Med., 9: 412-15(July 1968). (UCRL-17865).

Rubidium-82 decays by positron emission with a half-life of 75 sec and is the daughter of 25-day ^{82}Sr. The ^{82}Rb can be rapidly eluted from the parent by passing ammonium acetate solution or sodium chloride solution through a suitable ion-exchange column. In dogs and rabbits the heart is strongly labeled by infusing the eluted isotope into a vein for about 1 min, waiting for 2 min and then starting an exposure with the positron camera that lasts until the isotope has essentially decayed. A relatively high uptake is obtained in heart muscle compared with skeletal muscle, and the positron camera yields an excellent image of the heart. There is little concentration of the isotope in any other organs except the kidneys which also exhibit a high uptake of the isotope. (auth)

33771 INVESTIGATIONS OF DIFFERENTIAL SCANNING TECHNIQUES USING TWO RADIONUCLIDES. Cottrall, M. F.; French, Rosemary J.; Trott, N. G. (Inst. of Cancer Research, Sutton, Eng. Royal Marsden Hospital, Sutton, Eng.). pp 347-73 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

In the development of scanning procedures, difficulties sometimes arise because a particular radiopharmaceutical, that is selectively concentrated in an organ of interest, is also widely distributed in neighboring sites in the body. Investigations were made of a method that involved the use of a second radioactive substance to label such sites. By means of suitable electrical circuits fitted to a conventional mechanical scanner (Picker Magnascanner III), a direct color scan of the organ under study could be obtained. Signals from the two radionuclides were distinguished by pulse-height analysis and used to operate the color shift mechanism. Experimental studies with phantoms and clinical trials are reported. An analysis of the statistical limitations of the technique is given, including a discussion of the most suitable operating conditions for particular pairs of radionuclides. Illustrations include the use of ^{75}Se selenomethionine and ^{99m}Tc sulphur colloid or ^{198}Au colloid in the delineation of the pancreas, and reference is also made to work with ^{18}F, ^{99m}Tc, ^{113m}In, and ^{197}Hg, that were used in various chemical forms to visualize specific types of tumors in vascular surroundings labeled with other suitable tracers. Some discussion of the dosimetry of these procedures is made, since the extent to which the technique can be applied may be limited by the activities that can be administered. However, successful results are being obtained using activities within the range generally accepted for single radionuclide scanning procedures. For example, the pancreas can be successfully visualized using 250 μCi ^{75}Se selenomethionine in combination with 1 mCi ^{99m}Tc sulphur colloid. (auth)

33772 RADIATION EXPOSURE OF A PATIENT IN ROUTINE CLINICAL SCINTIGRAPHIC INVESTIGATIONS. Wolf, R. (Univ., Mainz). pp 829-41 of Medical Radioisotope Scintigraphy. Vol. I. Vienna, International Atomic Energy Agency, 1969.

From Symposium on Medical Radioisotope Scintigraphy, Salzburg, Austria. See STI/PUB-193(Vol.1); CONF-680804-(Vol.1).

Radiation exposure of a patient is a complex problem because physical, chemical, and biological factors are involved. Although the physical aspects of internal dosimetry of radioisotopes have been carefully considered during past years, little is known about the influence of the biological factors and their variation under normal and pathological conditions. The effect of differences in the purity of the radiopharmaceutical used and of the physiological, anatomical, and pathological variations in the function and size of the organs studied are described. Values of the absorbed dose are also given for investigations of children. (auth)

33773 RADIOACTIVE OSTEOTROPIC INDICATORS. Wojciechowski, Jerzy Marian. Pol. Przegl. Radiol. Med. Nukl., 32: 385-90(May-June 1968). (In Polish).

Diverse types of indicators with osteotropic properties and the practical application of these preparations in the diagnosis of bone pathology are discussed. The possibility of bone diagnosis by means of scanning using ^{32}P, ^{35}S, ^{72}Ga, ^{45}Ca, ^{85}Sr, and ^{87}Sr is also discussed. (auth)

33774 THE APPLICATION OF ^{99m}Tc IN ISOTOPE DIAGNOSTICS. Kowalczynska, Hanna; Tomaszewicz-Kubasik, Halina. Pol. Przegl. Radiol. Med. Nukl., 32: 375-83(May-June 1968). (In Polish).

The possibilities of using ^{99m}Tc for diagnostic examination of the thyroid, brain, lungs, liver, lymphatic system, placenta, vascular system, and the heart are discussed. (auth)

33775 TISSUE LOCALIZATION STUDIES OF A DDD ANALOG. DiGiulio, Walter; Beierwaltes, William H. (Veterans Administration Hospital, Ann Arbor, Mich. Univ. of Michigan, Ann Arbor). J. Nucl. Med., 9: 634-7(Dec. 1968).

A specific cytotoxic action on the adrenal cortex of dogs was demonstrated for 1-(o-chlorophenyl)-1-(p-chlorophenyl)-2,2-dichloroethane (o,p'-DDD). When an adequate dose was administered, the o,p'-isomer caused adrenal necrosis and suppression of adrenal function in humans, while the p,p'-isomer appeared to be relatively inactive. The mechanism of action is not understood. In addition to a direct adrenal effect, an effect on peripheral metabolism of corticosteroids was implicated. Some reports indicate that DDD or its metabolites concentrate in the adrenal. These findings suggested studies on the tissue distribution of an ^{131}I-labeled analog of p,p'-DDD as part of a program aimed at developing an effective radiopharmaceutical for adrenal gland photoscanning. Results are reported on the distribution of radioactive iodine in rabbit tissues 5 min to 24 hr after the intravenous administration of ^{131}I-1,1-(p-iodophenyl)-2,2-dichloroethane-(^{131}I-diiodo-DD). Preliminary results of attempts to visualize the adrenals in dogs by photoscanning are also reported. (C.H.)

33776 COMPARISON OF ^{99m}Tc-PERTECHNETATE AND ^{197}Hg-CHLORMERODRIN FOR BRAIN SCANNING. Sodee, D. Bruce (Hillcrest Hospital, Cleveland). J. Nucl. Med., 9: 645 (Dec. 1968).

A comparative study was made of the clinical accuracy of ^{197}Hg-chlormerodrin and ^{99m}Tc-pertechnetate brain scans. Residual scans were done 24 hr following the initial post-dose scans. Results showed that isolated metastatic lesions in the brain were visualized only on the residual scans. It is postulated that this finding is correlated with the fact that metastatic lesions are poorly vascularized and time is important for increased accumulation by the neoplasm and clearing of the radiopharmaceutical from the blood. It is suggested that 24-hr residual scans be used for all patients suspected of metastatic disease. (C.H.)

33777 PAPER CHROMATOGRAPHIC STUDY OF THE RADIOACTIVE CONTAMINANTS OF ^{131}I-HIPPURAN. Varga, Laszlo (National Research Inst. for Radiobiology and Radiohygiene, Budapest); Kelemen, Ilse; Kovach, Anna. J. Nucl. Med., 9: 604-7(Dec. 1968).

The importance of radiochemical purity of ^{131}I-labeled hippuran used for radioisotope renography is discussed. A mixture of benzene : acetic acid : water (2 : 2 : 1) was found to be the best solvent for separating ^{131}I-labeled o-iodohippuran from other organic and inorganic contaminating compounds in the product. Using this solvent, one-dimensional paper chromatography proved to be suitable both for qualitative and quantitative purposes. A hitherto unknown contaminating compound of ^{131}I-o-iodohippuran could be isolated by this one-dimensional paper-chromatographic procedure and was found to be ^{131}I-o-iodobenzoic acid. (C.H.)

33778 PHOTOSCAN REVERSAL: A VALUABLE AID IN PHOTOSCAN INTERPRETATION. Mante, Carl M.; Allen, Frank H.; Verdon, Thomas A. Jr. (Letterman General Hospital, San Francisco). J. Nucl. Med., 9: 610-12(Dec. 1968).

A method of producing reversal photoscans is described that has the advantage of suppressing background while providing enhanced contrast. Representative photoscans are presented together with reversal photoscans. Subtle differences in dense scans (liver, kidney, and lung) can be highlighted with this technique. Examples where this was helpful are presented to demonstrate areas of possible usefulness for the reversed photoscan. Limitations of applicability and interpretation are discussed. (C.H.)

33779 USE OF WHOLE-BODY COUNTER TO STUDY BODY RETENTION OF RADIOCOPPER IN WILSON'S DISEASE. Hamamoto, Ken; Tauxe, W. Newlon; Novak, Ladislav P.; Goldstein, Norman P. (Univ. of Minnesota, Rochester). J. Lab. Clin. Med., 72: 754-9(Nov. 1968).

Studies of body retention of ^{64}Cu were performed in seven patients with Wilson's disease, 14 heterozygous carriers, and nine normal subjects by the use of a whole-body counter. The reliability of this method as a screening test for Wilson's disease was investigated. The mean body retention of ^{64}Cu at 72 hr after intravenous injection was 97.5% of dose in the patients with Wilson's disease, 94.4% in the heterozygous carriers, and 87.8% in the normal subjects. Biologic half-time ($T_{\frac{1}{2}}$) of ^{64}Cu retention was 97.0, 39.4, and 17.1 days, respectively. Our observations suggest that study of the body retention of ^{64}Cu will make it possible to distinguish easily between heterozygous carriers and homozygous normal individuals and may be useful as a screening test to diagnose the carrier state in high-risk groups. (auth)

33780 ANALYSIS OF PRECORDIAL ISOTOPE DILUTION CURVES OBTAINED AFTER ANTECUBITAL AND INTRACARDIAC INJECTION. Campione, Kenneth M.; Steiner, Sheldon H. (Northwestern Univ., Chicago. Wesley Memorial Hospital, Chicago. Passavant Memorial Hospital, Chicago). J. Nucl. Med., 9: 630-3(Dec. 1968).

The external precordial isotope detection method for measuring cardiac output following antecubital injection of ^{131}I-labeled albumin compared favorably with the results of the Fick method in 13 patients with a variety of cardiac lesions. The external detection method requires injection into the peripheral venous system to measure cardiac output. When injections are made downstream into cardiac chambers and one or more cardiac chambers of the pulmonary circulation is bypassed, the method does not correlate well with cardiac output obtained by the Fick principle. Analysis of primary-passage curves obtained by precordial detection after antecubital injections showed that the right-to-left heart transit time, the time from peak count of the radioisotope into the right heart to the time of peak count into the left heart, did not correlate well with mean pulmonary artery pressure. The difference between the heart-to-head circulation time after antecubital and left ventricular injection, which is a measure of right heart to left ventricular transit time, correlated well with the mean pulmonary artery pressure. (auth) (TSS)

33781 RELATIVE IMPORTANCE OF RESOLUTION AND SENSITIVITY IN TUMOR DETECTION. Westerman, B.; Sharma, R. R.; Fowler, J. R. (Hammersmith Hospital, London). J. Nucl. Med., 9: 638-40(Dec. 1968).

The importance of the selection of a collimator for use with γ scintillation cameras for the production of Polaroid photographs of radioisotope concentration in vivo is discussed. Results are reported from a comparison of the point source resolution and sensitivity of two commercially available collimators for the detection of activity from ^{99}Tc. (C.H.)

33782 RADIODIAGNOSIS AND RADIOTHERAPY OF THE SKELETAL METASTASES OF MALIGNANT TUMORS OF THE THYROID GLAND. Ballarati, U.; Spreafico, G. L.; de Petra, V. Radiol. Med., 54: 766-91(Aug. 1968). (In Italian).

In a group of 345 cases of cancer of the thyroid gland, 70 patients presented metastases to the skeleton. Statistical data regarding incidence, age, sex, histologic type, and clinical-pathological pictures are reported. The x ray picture of the metastatic lesions is presented and the diagnostical role of the ^{131}I scanning is considered. Results obtained with x ray therapy and with ^{131}I therapy, together with the follow-up at various intervals from the beginning of the treatment are presented. (auth)

33783 INVESTIGATION OF THE OSTEOTROPIC PROPERTIES OF RADIOACTIVE CHROMIUM ^{51}Cr. PART II. Wojciechowski, Jerzy Marian. Pol. Przegl. Radiol. Med. Nukl., 32: 787-96(Nov.-Dec. 1968). (In Polish).

Results are presented of investigations of the osteotropic properties of ^{51}Cr. The assays were carried out in vivo and in vitro using 200 rats. It was demonstrated that chromium and ascorbic acid complexes have greater osteotropic properties in comparison with natrium chromate. Concomitant smaller accumulation of ^{51}Cr in blood and soft tissues was noted. The chromium-ascorbinic complex was applied in investigations of rats with injured epiphyseal cartilage after injection of varicosan preparation. The experiments carried out in vitro confirmed the osteotropic properties of ^{51}Cr. It was concluded that ^{51}Cr (specially in the chromium-ascorbic acid complex form) is applicable in the investigations of bone tissue and may be used, in this purpose, in investigations on humans. (auth)

33784 INVESTIGATION OF THE OSTEOTROPIC PROPERTIES OF RADIOACTIVE CHROMIUM (^{51}Cr). PART I. Wojciechowski, Jerzy Marian. Pol. Przegl. Radiol. Med. Nukl., 32: 537-47(July-Aug. 1968). (In Polish).

Results are presented of examination of the osteotropic properties of the ^{51}Cr in vivo. In normal bones, ^{51}Cr accumulates in marked quantities, the higher quantities of the isotope are present in the epiphyseal cartilages. Autographic techniques were used to estimate the quantitative and the qualitative relations. High accumulation of ^{51}Cr was noted also in the region of bone fracture in healing bones (experimental trauma). (auth)

33785 ANALYSIS OF THE RESOLVING POWER IN THE ESTIMATIONS OF RADIOACTIVITY USING AN ANGER TYPE SCINTILLATION CAMERA. Malesa, Jan. Pol. Przegl. Radiol. Med. Nukl., 32: 557-64(July-Aug. 1968). (In Polish).

The investigation of radioisotope distributions and concentrations in human organs was analyzed in the aspect of accidental errors in the estimation of radioactivity. Assuming a condition that the range of error deviations for the consequent estimations of isotope concentrations ought not impinge one on another, the indispensable numeric distances between the estimated activities were pointed out. In the results of the experiments, the dependence between the optical errors in scintigram readings and the physical parameters of scintillation camera were presented, together with the sums of scintillation impulses, measured in consecutive isotope activities. (auth)

Radiotherapy

Refer also to abstracts 33713, 33715–33717, 33725–33728, 33736, 33748, 33782, 33844, 33885, 33889–33891, 33893, 33895, 33896, 33898, 33899, and 34695.

33786 (NP-tr-1743) CURRENT APPLICATIONS OF ENDOLYMPHATIC THERAPY IN THE TREATMENT OF UTERINE CANCER. Dellepiane, G.; Tetti, A.; Davitti, L. Translated by L. C. Newman Bird (Atomic Energy Research Establishment, Harwell, Eng.), from Minerva Radiol., 11: No. 5, 219-29(1966). 27p. Dep.

Endolymphatic infusion of an oily ^{32}P solution may be substituted for lymphadenectomy accompanying hysterectomy in cervical cancer. This technique using ligation of the stained pelvic and lumbo-aortal lymphatics, followed by hystero-annectomy and subsequent infusion of 2 mCi of ^{32}P as $PO(OC_8H_{17})_3$, with Lipiodol and a few μCi of ^{131}I as tracing agent, is described in general and qualitative terms, and more specifically with diagrams, photomicrographs, x rays, and scintiscans. The method delivers 11 to 50 thousand rads to the lymph nodes, causing disappearance of the germinal elements, reduction of the lymphoid elements, and appearance of epitheoid elements which tend to necrosis. Zones of hyalinosis and connective sclerosis develop early and lead to disappearance of lymphoreticular tissue. One year after treatment 32 patients were in good condition and showed no sign of relapse or metastasis. This method is considered superior to an earlier treatment using ^{131}I because considerably more of the radioactivity remains within the lymphatic system, and because ^{32}P, being a pure β emitter, presents much less of a shielding problem. (C.O.)

33787 (UCRL-70163(Rev.1)) A STRATEGY FOR THE SELECTIVE DESTRUCTION OF CANCER CELLS. Hart, Roger G. (California Univ., Livermore. Lawrence Radiation Lab.). Dec. 26, 1967. 15p. (CONF-670733-1). Dep. CFSTI.

From 5th International Congress of Chemotherapy, Vienna, Austria.

It is proposed that cancers can be cured by a strategy consisting of two complementary kinds of treatment. The first, which is called A, is one that reversibly suppresses mitosis of normal host cells, but not of cancer cells; the second, called B, is one that kills dividing cells or cells that are preparing to divide. The B treatment is a mitotic poison. It destroys dividing cells selectively, while leaving intact all of the postmitotic, differentiating, or intermitotic cells which are not preparing to divide. The advantages of tritiated thymidine as a B treatment are discussed.

It is suggested that the use of 5-iododeoxyuridine together with tritiated thymidine would be effective. The function of the A treatment is to protect normal cell populations. A must temporarily prevent substantial fractions of normal cells from synthesizing DNA while permitting all cancer cells to do so. Hormones, hypertransfusion, and fasting are discussed as mechanisms for controlling mitosis of normal cells. (H.L.W.)

33788 NEW TECHNIQUE FOR TUMOR RADIOTHERAPY USING HYPERBARIC OXYGEN. Scolari, E. G.; Nannelli, M.; Vallecchi, G.; Mantellassi, G. (Univ., Florence). Nunt. Radiol., 33: 1077-98(Sept. 1967). (In Italian).

The radiobiological and radiochemical fundamentals of the oxygen-effect are reviewed, and the therapeutic applications reported in the literature are discussed. A new technique for the radiotherapy of neoplasms in hyperbaric oxygen is described. The advantages of this technique are caused by the fact that the radiation sources are placed inside of the hyperbaric room. The size of the room allows a comfortable environment, where the patients tolerate without disconfort exposures resulting in a total tumor dose of 4000 to 8000 R given over a period of up to three hours. The problems from the oxygen toxicity and the criteria followed successfully to prevent the development of convulsions are discussed, and results are reported for various neoplasms irradiated by this new procedure following the administration of an inhibitor of the anaerobic glycolysis. The results obtained appear quite positive, especially in highly radioresistant forms, such as malignant melanomas and lymphglandular metastases. (auth)

33789 FURTHER IMPROVEMENTS IN THE METHOD OF COMBINED RADIATION TREATMENT OF PATIENTS WITH CANCER OF THE CORPUS UTERI. Tobilevich, V. P. (Inst. of Oncology, Leningrad). Vop. Onkol., 15: No. 3, 27-33(1969). (In Russian).

The elaboration and improvement of the technic of combined radiotherapy in patients with cancer of the uterine body are dealt with. As to the diagnosis, an apparatus was devised that permits simultaneous determination of the uterine cavity volume and accomplishment of hysterography, thus providing a localization of the tumor process and possibility of aimed biopsy, maintenance of control over most rational displacement of point — radiators in the uterine cavity. Hysterography in combination with concomitant lymphography provides information on the extent of the tumor process. As to the treatment, a construction of the chain applicator was modified, that facilitated its insertion in the uterine cavity and provided most optimum distribution in accordance with the definite uterine volume. The control over dosage was maintained, using the A. A. Stankevich method, that enabled calculations of doses from radiators of various geometrical form and size occupying any position in the pelvis. The above mentioned method was used in 15 patients with cancer of the uterine body (stage II — 10 cases, stage III — 5). Observations of patients within a period from 3 to 11 months following this therapy have demonstrated their complete clinical recovery. (auth)

33790 BLADDER CANCER: AN EVALUATION OF DIAGNOSIS AND TREATMENT OF 93 PATIENTS. Brown, H. Michael; Elliot, James S. (Veterans Administration Hospital, Martinez, Calif.). J. Urol., 102: 63-6(July 1969).

A review of treatment of 93 patients with bladder cancer is presented. Results are in general agreement with previous reports. The majority of deaths caused by cancer occurred in the first year after initial diagnosis (15 of 24). A significant number of patients died of metastatic disease without local recurrence in the bladder. Cobalt therapy may have some value as palliative therapy but shows little potential for cure in the doses used. The results appear to be no different from those of external roentgen therapy reported 17 years ago. Cystectomy and ureteroileal diversion appear to be the only treatment offering real hope for cure in patients with stage B1 tumors. Cystectomy should be considered in those patients with histological malignancy or persistently recurring superficial tumors before deep invasion is evident. (auth)

33791 RADIOTHERAPY OF EPIDERMOID SKIN CARCINOMAS WITH ^{192}Ir. Pierquin, B.; Chassagne, D.; De Maio, G.; Beyer, H. (Institut Gustave-Roussy, Villejuif, France). Ann. Radiol., 12: R57-65(1969). (In French).

The results of endocurietherapy with iridium 192 of epidermoid skin carcinoma suggest that the method marks an advance in the radiotherapy of these conditions. The ease of use of the material, the good conditions of protection due to nonradioactive preparation and accurate dosimetry (improved by the use of the computer) allow complete cure to be achieved in all localized forms T1 and T2) and in the majority of cases with more extensive lesions (more than 90% in T3 and T4 cases). There are a few reservations which are dealt with in the discussion. Lesions which have recurred after previous treatment (by surgery or radiation) are amenable to treatment by this method and the results are comparable (80% cure rate in recurrences as against 90% in new cases). In spite of the advanced age of most of the patients with epidermoid cancers of the skin it is desirable to achieve a cure using a non-mutilating, short duration treatment such as the method described. (auth)

33792 RADIOLOGY AND RADIOTHERAPY OF THYMIC TUMORS. Legre, J.; Clement, J.-P.; Amalric, R.; Clement, R.; Robert, F. (Hopital de La Timone, Marseille. Centre Anticancereux, Marseille). Ann. Radiol., 12: R12-29(1969). (In French).

The various methods of radiological examination of thymic tumors are reviewed and findings in 21 cases of which 7 were benign and 14 malignant are described. They stress the usefulness of gas mediastinography according to the technique of Bariéty and Coury and the difficulty of differentiating between benign and malignant lesions. Ten cases of malignant thymic tumors treated with either conventional or cobalt radiotherapy are also described together with the 34 cases of malignant thymic tumors treated by radiotherapy collected from the literature during the past ten years. Thymic tumors should always be irradiated and high doses, in the region of 5 to 6,000 Rads are necessary. Death in the majority of cases occurs early, 30% of patients having died within the first year (14 out of 44). Of the 25 cases followed up for 5 years there were 8 survivors, that is 32%. The prognosis appears to be better for the reticulo-epithelial type of tumor than for the predominantly thymocytic type. Two cases of reticulo-epithelial thymomas irradiated in the series showed a favorable outcome. (auth)

33793 OPTIMUM ENERGY IN SUPERVOLTAGE X-RAY THERAPY. Kitabatake, Takashi; Hattori, Hiroyuki; Okumura, Yutaka (Niigata Univ., Japan). Strahlentherapie, 137: 158-61 (Feb. 1969).

Considerations on optimum energy range in therapeutic use of supervoltage x rays are described. For practical radiotherapy, four conditions are desirable: small skin dose during entrance and exit, small side-scattering dose, small bone absorption dose, and large dose in lesion and small integral dose in other parts of the body. Each of these factors is discussed, and it is concluded that the most useful range in x radiation for therapy is 3 to 35 MeV, and the optimum lies near 9 to 10 MeV in generating voltage. (tr-auth)

33794 PENDULAR IRRADIATION WITH TRANSVERSAL MOVEMENT OF THE AXIS IN ^{60}Co TELETHERAPY. II. TRANSVERSAL MOVEMENT OF THE PENDULAR AXIS ALONG THE BISSECTRICE. Kuttig, Helmut; Schiller, Gudrun (Univ., Heidelberg). Strahlentherapie, 137: 152-7(Feb. 1969). (In German).

Isodose distributions were determined experimentally for pendular telecobalt irradiation combined with transversal movement of the pendular axis along the bissectrice. The influence of the field surface and the pendular angle was also studied. (tr-auth)

33795 STUDIES ON THE INFLUENCE OF WEDGE FILTERS AND SURFACE INCLINATIONS ON THE COURSE OF ISODOSE CURVES IN ^{60}Co TELETHERAPY. Sonntag, Albrecht (Univ., Munich). Strahlentherapie, 137: 142-51(Feb. 1969). (In German).

The wedge angle α and the obliquity τ of incidence result in an inclination of the isodose in similar manner to an angle ω, which can thus be calculated in the same way. Measures confirm that $tg\omega$ depends directly on $tg\alpha$ and $tg\tau$, as theory forecasts. So a nomogram was established for treatment planning, in order to choose the isodose angle φ depending on the wedge angle α and the angle τ of the oblique incidence. Inversely α can be determined from φ and τ. Other particular problems of dose distribution for wedge filters and for oblique incidence are discussed. (tr-auth)

33796 INTERSTITIAL CURIE THERAPY WITH RADIOACTIVE FILAMENTS. Sahatchiev, Andrea; Moushmov, Marin (Wissenschaftliche Forschungsinstitut fuer Onkologie, Sofia). Strahlentherapie, 137: 137-41(Feb. 1969). (In German).

A new method for application of radioactive wire that is introduced in the cavity of a hollow surgical thread and fixed with perchlorvinyl resin is presented. This radioactive wire, with or without double overloaded activity at both ends, can be used as hairpins or linear sources. For implantation in the urinary bladder, the introduction of the radioactive sources is performed only when bladder and abdominal wall are partly closed. By this method, the dose to the operator is greatly reduced. When the interstitial radiotherapy is combined with radical surgical dissection of the regional cervical lymph nodes for tumors of the

oral cavity, the radioactive wires are introduced with the method of dose fractionation. Postponing the interstitial therapy to the time when the surgical scar has healed, and with daily fractions of 400 to 500 rad, a total dose of more than 7000 rad can be obtained without complications. (tr-auth)

33797 SIMPLE MODIFICATION OF THE STOCKHOLM APPLICATOR FOR THE TREATMENT OF EARLY CANCER OF THE UTERINE CERVIX. Zarghami, Gholam H.; Kurohara, Samuel S. (Roswell Park Memorial Inst., Buffalo). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 105: 115-19(Jan. 1969).

A modification of the Stockholm technique of radium treatment of cancer of the uterine cervix is described. This modification seems most suitable for early lesions and was used regularly. Although the number of patients treated is not large enough to warrant a statistical assessment, all the applications were satisfactory. (C.H.)

33798 SURGICAL MANAGEMENT OF SOLID TUMORS IN CHILDHOOD. Martin, Lester W. (Univ. of Cincinnati. Children's Hospital, Cincinnati). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 105: 105-9(Jan. 1969).

An aggressive, optimistic attitude with a team-type approach, including the pediatrician, the surgeon, the radiologist, the chemotherapist, and the pathologist, constitutes the essentials for the management of the soft tissue solid tumors of childhood. The results are reported for 50 cases of Wilms' tumor, a number of cases of neuroblastoma and malignant lymphoma, and three cases of rhabdomyosarcoma treated with pre-operative or post-operative γ or x radiation. (C.H.)

33799 COMBINED INTRA-ARTERIAL INFUSION AND RADIO-THERAPY FOR THE TREATMENT OF ADVANCED CANCER OF THE HEAD AND NECK. Jesse, Richard H.; Goepfert, Helmuth; Lindberg, Robert D.; Johnson, Robert H. (Univ. of Texas, Houston). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 105: 20-5(Jan. 1969).

Thirty-four of 46 patients with advanced cancer of the head and neck were able to complete a course of concomitant intraarterial chemotherapy using 5-fluorouracil and methotrexate and ^{60}Co γ-radiotherapy. Twelve of the 36 patients had no local recurrence although some of these died of distant metastases, second primary malignant neoplasms, and other causes. Ten of the patients had a complete disappearance of the lesion only to have it recur later. The remaining 12 patients had no local control of their cancer or were unavailable for follow-up. Eight of the 34 patients were living free of their disease 18 months or more after completion of therapy. Patients in whom the entire cancer was in the distribution of the external carotid artery are the only survivors. It is felt that this pilot program produced more success in the local control of cancer than would normally be expected if chemotherapy had not been employed. A carefully controlled series will be necessary to assess the value of this approach. (auth) (TSS)

33800 RESPONSE TO RADIATION THERAPY OF OSSEOUS LESIONS DETECTED ON RADIOISOTOPE BONE SCANS. Baum, Sheldon; Davenport, James H.; Silver, Lawrence (Long Island Jewish Hospital, Jamaica, N. Y.). Amer. J. Roentgenol., Radium Ther. Nucl. Med., 105: 137-41(Jan. 1969).

In a group of 13 patients with known primary neoplasms, radiotherapy (^{60}Co γ or 250 kvx) for symptomatic relief of pain was directed at osseous metastases detected on ^{85}Sr bone scans but which were not seen on roentgenograms. The response was considered to be good in nine patients, fair in three, and poor in one. It is probable that these early lesions, detected on bone scans before sufficient bone destruction had occurred to enable them to be seen on roentgenograms, are more sensitive to radiotherapy than fully visualized metastases. (auth)

33801 THE APPLICATION OF THE RADIOACTIVE COBALT (^{60}Co) FOR THE TREATMENT OF THE UTERINE CERVIX CANCER USING THE AFTERLOADING APPLICATION TECHNIQUE. Marzecki, Zbigniew. Pol. Przegl. Radiol. Med. Nukl., 32: 113-20(Jan.-Feb. 1968). (In Polish).

The application of ^{60}Co applicators for γ implant therapy of uterine cervix cancer using the afterloading technique is described. The method consists of placing the empty applicators inside the uterine cavity and in the vaginal vaults. The ^{60}Co is then inserted after checking the proper localization of the applicators by means of radiograms. The types of applicators, especially designed for this purpose, and the mobile lead container for transport of the loads of ^{60}Co are described. The pros and contras of the technique are discussed with special reference to the utilization of ^{60}Co instead of radium. Special attention is paid to the advantages of ^{60}Co utilization in the afterloading procedure with the pretherapeutic preparation of the applicators in situ. (auth)

Blast and Thermal Effects

33802 THE RELATIONSHIP AMONG SEVERAL PRENATAL FACTORS AND VARIATION IN THE PERMANENT DENTITION IN JAPANESE CHILDREN. Bailit, Howard L. (Univ. of Connecticut, Hartford); Niswander, Jerry D.; MacLean, Charles J. Growth, 32: 331-45(Dec. 1968).

Influence of prenatal environment on the permanent dentition, with emphasis on variation in tooth eruption, development, and caries, was studied in Nagasaki children, who from 1948 to 1953 were examined by the Atomic Bomb Casualty Commission for radiation damage from the 1945 nuclear explosion. As part of this study, a questionnaire was given to pregnant women, asking for information on their past reproductive history and present pregnancy. A portion of this sample of children had been used in a study of the effects of inbreeding on fertility and growth. Children whose parents had received significant radiation exposure were not included in the inbreeding study. At this time records were collected on the dentition, which included: the number of permanent teeth erupted, and number of decayed, missing, and filled permanent and deciduous teeth. Birth weight, length of gestation, parity, maternal age, and number of previous stillbirths were examined for their influence on the development, eruption and prevalence of caries in the permanent dentition. The sample consisted of 3066 children, 1511 males, and 1555 females from Nagasaki, approximate half born of related parents. They ranged in age from 6 to 12 yr with a mean age of 8.49 yr. Results showed that children lighter at birth erupted their teeth at a significantly later age. The same trend was seen for tooth formation, but the correlations were not statistically significant. Also there was a low negative significant relation between caries prevalence and birth weight. While these findings could indicate the influence of the postnatal environment or the genotype of the child on dental eruption and caries, the data suggest that prenatal maternal effects are responsible. (BBB)

Radiation Effects on Animals

Refer also to abstracts 33626, 33675, 33828, 33830, 33832, and 33848.

33803 (AD-680946) THE EFFECT OF LASER ENERGY ON CELLS IN TISSUE CULTURE. Annual Summary Report No. 1. Rounds, Donald E. (Pasadena Foundation for Medical Research, Calif. Dept. of Laser Biology). Jan. 6, 1969. Contract DA-49-193-MD-2564. 20p. CFSTI.

Ruby laser irradiation causes nonpigmented cells to deposit an agent into the surrounding culture medium that can promote RBC agglutination, blood clotting, WBC chemotaxis, and stimulation of cell growth. Blue and green laser wavelengths produced mitochondrial swelling in beating rat heart cells. Morphological changes suggest that a toxic substance is lost from these structures, which results in nuclear pycnosis and death of the cell. A variety of drugs were observed to photosensitize individual mitochondria to an argon laser microbeam. These included various forms of tetracycline, DNP, amytal, and NaF. (auth) (USGRDR)

33804 (PHS-PUBL.-1809) RADIATION BIO-EFFECTS. Summary Report, January-December 1968. Hodge, Donald M. (comp. and ed.) (Bureau of Radiological Health, Rockville, Md.). 121p.

Summaries of the research efforts of the Division of Biological Effects during 1968 are presented. The first part of the report outlines the administrative organization of the program and the laboratories that comprise it. Publications and presentations by program investigators during 1968 are listed. Separate abstracts were prepared for the summaries of research in progress at the six laboratories. These seven papers will be included in NSA. (C.O.)

For abstracts of individual papers see: 33595, 33708, 33805, 33806, and 33832-33834.

33805 (PHS-PUBL.-1809, pp 1-4) RADIATION BIO-EFFECTS PROGRAM. (Bureau of Radiological Health, Rockville, Md.).

The Radiation Bio-Effects Program (RB-E), Bureau of Radiological Health, conducts a multidisciplinary research program aimed at defining the long-term effects of low-level radiation exposures in man. The RB-E program is organized into six laboratories: physiology and biophysics, radioisotope toxicology, radiation oncology and pathology, radiation physics, radiation cytology, and the collaborative radiological health laboratory; these laboratories are supported by the biometric and animal care units. The Biometrics Support Unit provides statistical design and data analysis services and the Animal Care Unit provides animals and animal care for the

studies conducted by the RB-E program at Rockville, Maryland. (C.O.)

33806 (PHS-PUBL.-1809, pp 5-19) RADIATION CYTOLOGY LABORATORY. Leach, William M. (Bureau of Radiological Health, Rockville, Md.).

The Radiation Cytology Laboratory examines cellular responses to radiation; primarily, morphological studies are made to relate the extent of an effect to the radiation exposure. Human studies include radiation effects on peripheral leukocytes, chromosomal analysis of patients during treatment for chronic lymphocytic leukemia, chromosomal analysis of persons with body burdens of mixed radioisotopes, studies on possible etiologies of congenitally defective aneuploid humans, x-ray effects on the nucleolus and on its role in chromosome distribution, and ultrastructure of x-irradiated chromosomes. Animal studies include influence of age or incidence of chromosomal aberrations in the thyroid, effect of ^{131}I on incidence of thyroid tumors, chromosome stickiness and division delay in irradiated cultured cells, effects of x-ray quality on chromosome aberration yields, effects of rat kangaroo hematopoietic cell lines on survival of x-irradiated animals, and in vitro cultivation of the seminiferous epithelium of Chinese hamsters. Brief summaries of the animal and human studies are presented. (C.O.)

33807 EFFECT OF THE RUBY LASER MICROBEAM ON MITOCHONDRIA OF KB CELLS SUPRAVITALLY STAINED BY PINACYANOL. Tanaka, Yasukazu (Hopital de Bicetre, Paris). J. Cell Biol., 41: 424-30(May 1969).

With pinacyanol as the supravital stain, a preferential effect on mitochondria of KB cells was achieved by the irradiation with the ruby laser beam. The observation confirmed the results of other workers using janus green B in the same experimental system. The preferential effect on mitochondria was noted in the area extending 8–10 μ beyond the nonpreferential damage of 4–5 μ in diameter. The opaque material associated with mitochondria possibly represented coagulated protein. The effect involved cristae mitochondriales without severe disarrangement of their structure. The opaque material could be interpreted as the result of direct interaction between mitochondria and the laser beam, even though the mitochondria were noted outside of the previously estimated focal spot size of about 3 μ. Within the thickness of 2–4 μ of monolayered cells, larger areas of damge can be accounted for by divergence of the beam which is focused by a microscope objective of very short focal length. A threshold of biologic effectiveness is probably also involved. (auth)

33808 ULTRAVIOLET CYTOSPECTROPHOTOMETRY OF LIVING CULTURED CELLS: EXPERIMENTAL PROCEDURES AND ABSORBANCE SPECTRA. Freed, Jerome J.; Engle, James L. (Inst. for Cancer Research, Philadelphia). Contract AT(30-1)-2356. Ann. N. Y. Acad. Sci., 157: 195-210(Mar. 31, 1969). (NYO-2356-23).

From Conference on Data Extraction and Processing of Optical Images in the Medical and Biological Sciences, New York. See CONF-670635.

The vibrating mirror flying spot microscope, in double-beam form, was developed to carry out cytospectrophotometry of living cells in the ultraviolet. Features required for investigation of cultured mammalian cells are described; these include a template-controlled integrator for measurement of photometric fields of irregular shape, and an automatic system for rapid movement of the slide to predetermined positions for measurement of cell and free-space. Tests of photometric performance are described. An ultraviolet-transparent growth medium is employed to maintain the cells during photometric studies. During normal interphase growth of Chinese hamster cells, total absorbence at 260 mμ was found to increase linearly throughout most of the interphase, becoming constant during a plateau of a few hrs duration prior to mitosis. Continuous exposure to actinomycin D at concentrations greater than 5 μg/ml caused a decrease in total absorbance at 260 mμ. At lower concentrations, fluctuations in absorbence were observed that were tentatively attributed to changes in the scattering properties of the cells. Integrated absorbence spectra of whole cells were, in the majority of cases, free from effects of light scatter; however, the ratios of A_{245}/A_{280} were sufficiently high (near 3.0) to suggest the need for further investigation of the nature of the absorbing substances in intact living cells. (auth)

33809 ELECTRON MICROSCOPIC STUDY OF CANCER OF THE UTERINE CERVIX WITH SPECIAL REFERENCE TO CHANGES DUE TO RADIATION. Ito, S. Nippon Sanka Fujinka Gakkai Zasshi, 19: 1489-96(Dec. 1967). (In Japanese).

Radioinduced morphological changes of malignant cells were investigated by electron microscopy after exposure of the cells to varying doses of γ radiation from ^{60}Co and/or Ra sources. Close-range and long-range exposures corresponding to a depth dose of 200 R were used at doses up to 400 R for single irradiations at the surface. Tissue samples were examined from 1 day to 2 weeks after exposure. It was found that granules start to accumulate at the edge of the cell walls after about 1800 R, but the resistance of the cell walls remained high. At the same time the intercellular voids began to expand; this expansion progressed with time. The cell mitochondria showed quite early the effects of radiation injury, exhibiting swelling of the lumen, followed by rupture after exposure to 1800 R and destruction after 3000 R. Changes in the nuclear material as indicated by coagulation near the edges were found after exposure to about 2000 R. The double layer structure of the nuclear membrane disintegrated after exposure to 8000 R or more. Major changes were observed in the interstitial cells at about 3000 R, minor ones at about 1800 R. Cellular material, other than the nucleus exhibited signs of injury which increased with time after a single exposure. Nuclear injury was found to be slight, appearing only about two weeks after a single exposure. (TTT)

33810 DO CULTURED MAMMALIAN CELLS REPAIR RADIATION INJURY BY THE "CUT-AND-PATCH" MECHANISM. Dalrymple, G. V.; Sanders, J. L.; Baker, M. L. (Univ. of Arkansas, Little Rock). J. Theor. Biol., 21: 368-86(Dec. 1968).

It is shown that the "cut-and-patch" hypothesis, such as described for micro-organisms, explains many of the important effects of radiation on cultured mammalian cells. Radiation interacts with the nuclear DNA to produce alteration of the bond structure of the DNA molecule. Nucleolytic enzymes (nucleases) present throughout the nucleus are thought to "scan" the DNA molecules for bond abnormalities, such as produced by irradiation. If appropriate bond abnormalities are found, the nucleases attack the altered sites and produce breaks in the DNA strand. The original radiation-induced bond abnormality is then converted into a break in the DNA molecule. If the break involves only one of the paired DNA strands, it can be closed by the action of the enzyme responsible for repair of DNA breaks (DNA polymerase). The results of experiments with cultured mammalian (L) cells are described which reflect upon the validity of this model. Periods of cyclic incorporation and loss of DNA precursors during the first few postirradiation hours were found; however, no relation to the repair process was established. Consequently, it is not known whether the periods of nonconservative DNA replication represent trivial radiation-induced effects of phenomena of importance. Mathematical analysis suggested that the structure of the paired dose survival curve may not reflect the biologic repair process per se. Instead, the structure would seem to occur as a consequence of the passive relaxation of DNA bond abnormalities. It is believed that the repair of sublethal radiation injury is a metabolic process which requires energy. Certain metabolic inhibitors, while preventing induction and/or action of nucleolytic enzymes, create a stalemate. The abnormal bonds exist after irradiation, but they cannot be functionally broken. The cell benefits from this period because of the relaxation of some of the abnormal bonds. When protein synthesis and/or other energy requiring functions are resumed (after replacement of the inhibitor with complete medium), breaks occur, and some of the breaks – if single stranded – can be repaired. The cell benefits when some bonds are converted from potential double- to single-stranded breaks. (BBB)

33811 INTERACTION BETWEEN PERIPHERAL BLOOD LEUCOCYTES AND X-IRRADIATED CELLS FROM LYMPHOID CELL LINES. Hardy, D. A.; Ling, N. R.; Knight, Stella C. (Univ. of Birmingham, Eng.). Experientia, 25: 404-6(Apr. 15, 1969).

Freshly isolated human blood lymphocytes were mixed with x-irradiated lymphoid cell lines. The activation of the lymphocytes into blast cells that synthesized DNA and underwent mitosis were observed using ^{3}H-labeled thymidine. The cells of 20 individuals were tested with irradiated EB cells and marked activation was observed. The timing of the response varied slightly with the donor and the cell line. Preserved (frozen) EB cells gave no stimulation when mixed with peripheral cells. The increased DNA synthesis observed when irradiated and normal lymphoid cells were mixed in culture is discussed. (C.O.)

33812 EFFECT OF β RADIATION ON NEURAL TRANSMISSION IN THE ISOLATED CERVICAL SYMPATHETIC GANGLION OF THE RAT. Welti, Hansjoerg (Univ., Lausanne, Switzerland). Helv. Physiol. Pharmacol. Acta, 26: 278-86 (1968). (In French).

Electrophysiologic activity of the isolated ganglion exposed to ^{32}P and ^{90}Sr β radiation was studied. A solution of 5 mCi ^{32}P gave a dose rate of 400 rad/hr and a 20 mCi source of ^{90}Sr sealed in Ag was used to give a dose rate of 7.2 rad/sec. The superior cervical ganglion of the rat was placed in a Krebs solution at 36°C. Electrophysiologic response was registered as the action

potential of the postganglionic nerve after preganglionic stimulation. After exposure to a moderate radiation dose during a limited time or after continuous exposure to a low dose of radiation, the ganglions showed an impaired response, evident by an early, sudden fall in action potential. This occurred at 8 hr, after a total dose of 3.2 Krad had been received. After exposure to a moderate radiation dose (240 Krad, 8 hr) this fall may be preceded by a slight increase of short duration in the action potential. The impairment of the electrophysiologic action is partially due to a modification of the ionic permeability of ganglion membranes, but the main reason of this irreversible injury remains unknown. (BBB)

Invertebrates

Refer also to abstracts 33668–33671 and 33687.

33813 (COO-1033-17) BASIC FERTILIZATION PHENOMENA AND GAMETIC LETHALITY IN DROSOPHILA. Final Report. Yanders, A. F. (Michigan State Univ., East Lansing). May 29, 1969. Contract AT(11-1)-1033. 31p. Dep. CFSTI.

Studies on insemination involved direct observation of sperm contained in the spermatheca and ventral receptacle or inseminated females. Insemination success in the 36 possible combinations of matings among six geographical strains of Drosophila melanogaster was measured. Results indicated that the strain of both mating partners was significant in insemination success. Effects of age and mating history of the male on the size of spermatophores and insemination success were studied. Exposure of sperm to x rays reduced the success of insemination in proportion to the dose. The reduction was linear at doses of 4,000 to 40,000 R and became more abrupt from 40,000 to 70,000 R. Adult males grown on cultures containing tritiated thymidine were mated to non-labeled females. After insemination the ventral receptacle was dissected for autoradiographic studies. Effects of age and physiological differences on x-radioinduced genetic damage to sperm cells were studied. Abnormal progeny ratios were investigated with regard to behavior of sex chromosomes and segregation-distortion studies. Effects of radiation on meiosis were studied. (H.L.W.)

33814 POLYMORPHISM IN NATURAL POPULATIONS FOR GENES CONTROLLING RADIORESISTANCE IN DROSOPHILA. Parsons, P. A.; Macbean, I. T.; Lee, B. T. O. (La Trobe Univ., Bundoora, Victoria. Univ. of Melbourne). Genetics, 61: 211-18(Jan. 1969).

Eighteen strains set up from single inseminated females of Drosophila melanogaster derived from a wild population were shown to differ in radioresistance and radiosensitivity as measured by percentage mortalities following irradiation with ^{60}Co γ rays. A 4 × 4 diallel cross between two of the resistant and two of the sensitive strains showed that the differences between these four strains were mainly due to additive genes. This was further explored for one resistant and one sensitive strain using chromosome assay techniques. It was shown that the main difference between these two strains was due to additive genes on the second and third chromosomes. The variation between the 18 strains argues, as in a number of quantitative traits, for polymorphism for the genes controlling radioresistance and radiosensitivity in natural populations. (auth)

33815 EXPERIMENTAL MORPHOGENESIS WITH THE CILIATA: II. EFFECTS OF A UV IRRADIATION ON THE DIFFERENTIATION OF THE CILIA IN PARAMECIUM AURELIA. Haller, Gerard (Univ., Geneva). Rev. Suisse Zool., 75: 583-7(Sept. 1968). (In French).

Effects of uv irradiation with a dose of 0.002 μW/cell of Paramecium aurelia in the region of 2537 Å were studied. The irradiation was 94% lethal. The surviving clones showed structural alterations of their cilia, even after many division cycles. Although the kinetosomes appeared normal, the cilia were swollen and lacked their typical longitudinal fibers. The peribasal vessels were absent. The perisomal sac was hypertrophied. The significance of the changes observed was discussed, and it was concluded that their persistence over many generations indicated genetic changes produced by the uv irradiation. (BBB)

33816 DENSITOMETRIC CYTOPHOTOMETRY OF CHROMOSOMES IN THE ULTRAVIOLET. Rudkin, G. T.; Engle, J. L. (Inst. for Cancer Research, Philadelphia). Ann. N. Y. Acad. Sci., 157: 525-30(Mar. 31, 1969).

From Conference on Data Extraction and Processing of Optical Images in the Medical and Biological Sciences, New York. See CONF-670635.

A method is described for the densitometric scanning of photographic plates to distinguish and measure the integrated uv-absorbence of an intracellular structure of the intact cell. The absorbence spectra for chromosomes of Drosophila melanogaster are the object of this study. Techniques are described and results illustrated. (E.R.B.)

33817 STUDIES ON THE CELLULAR BASIS OF RADIATION LETHALITY. III. THE MEASUREMENT OF STEM-CELL REPOPULATION PROBABILITY. Lange, C. S.; Gilbert, C. W. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Biol., 14: 373-88(1968).

A model is presented which defines the parameters of the curve for neoblast (stem cell) survival of reproductive integrity in terms of the parameters of the planarian radiation mortality curve. Two constants of the model, namely, the initial number of neoblasts (N) and the repopulation probability (α) for the independent repopulation of the irradiated planarian tissues by surviving neoblasts were defined and, for the species Dugesia lugubris, measured. The assumption that the repopulation probability for each neoblast is independent of the number of neoblasts was confirmed experimentally for diploid and triploid neoblasts of exogenous and endogenous origin. The repopulation probability for diploid (endogenous and exogenous) and triploid (endogenous only) neoblasts were not significantly different. Triploid exogenous neoblasts, however, were only 16 percent as effective as endogenous triploid or exogenous diploid neoblasts. Values of D_0 and $N\alpha E$ (E = extrapolation number) were given for diploid, triploid, and tetraploid neoblasts of D. lugubris, and for four other species. (auth)

33818 EFFECTS OF ^{60}Co GAMMA IRRADIATION ON THE REPRODUCTIVE PERFORMANCE OF THE BRINE SHRIMP, ARTEMIA. Holton, Robert Lawrence. Corvallis, Oreg., Oregon State Univ., 1968. 81p.

Thesis.

The brine shrimp, Artemia, was used as an experimental organism to study the effects of ^{60}Co γ irradiation on the reproductive performance of an animal population. The total reproductive ability of the brine shrimp was fractionated into various components and the effects of irradiation on each of these components was then determined by studies of reproductive behavior in individual pair matings. In this study, the components identified were the number of broods produced per pair, the number of nauplii voided per pair, the number of nauplii voided per brood, the survival of nauplii to sexual maturity, the number of mature adults produced per brood, and the number of mature adults produced per pair. All component parameters of total reproductive performance were shown to be affected by irradiation. However, the number of broods per pair was shown to be the factor most affected by doses of 1200 rads or less. It was determined that for Artemia irradiated at the most sensitive stage, a dose of 2100 rads produced sterility. At less sensitive stages, more than 3000 rads would be required to produce sterility. In a single experiment, Artemia irradiated with 300 rads gave an indication of a slight enhancement of reproductive ability as compared to the control animals. In all cases, doses of 600 rads or less showed little effect on the reproductive ability of this species. (TSS) (Disser. Abstr.)

33819 THE OBSERVATIONS ON THE INFLUENCE OF A SMALL DOSE OF X-RAYS ON THE CONJUGATING PARAMECIA. Komala, Zofia (Dept. of Experimental Zoology, Krakow). Folia Biol. (Krakow), 16: 299-306(1968).

Conjugating Paramecium aurelia were irradiated with a single dose of 9 R x radiation in the prophase stage (the crescent stage) of the first meiotic division. The results indicated that this dose has a stimulating effect on the growth and reproduction of exconjugants of P. aurelia in the F_1 generation. Observations carried out on the F_2 obtained from an irradiated F_1 by conjugation showed that this stimulating influence is transitional. (auth)

Vertebrates

Refer also to abstracts 33595, 33620–33622, 33630, 33631, 33633–33636, 33642–33645, 33648–33652, 33655–33658, 33660, 33681, 33682, 33701, 33708, 33729, 33740, 33741, 33744–33747, 33806, and 33910.

33820 (AD-680748) RESEARCH WITH THE PRIMATE EQUILIBRIUM PLATFORM IN A RADIATION ENVIRONMENT. Technical Report, January–September 1967. Barnes, Donald J. (Systems Research Labs., San Antonio, Tex.). Aug. 1968. Contract AF41(609)-2724. 15p. (SAM-TR-68-81). CFSTI.

A revised Primate Equilibrium Platform (PEP II) was designed and constructed to further investigate the effects of pulsed ionizing radiation on the equilibrium function. Twenty rhesus monkeys were trained to maintain a platform-horizontal position by the manipulation of a joy stick. Thirteen of the primates received an approximate midhead dose of 1,000 Rads, and six re-

ceived an approximate midhead dose of 2,500 Rads. One animal was omitted from the final results owing to a technical problem. After irradiation, 13 animals were tested for 1 hour and the remaining six animals were tested for 3 hours, as these were actually two separate experiments 4 months apart. The major dependent variable was the time spent on horizontal per trial. Results demonstrated a definitive dose-level effect in the occurrence of early performance decrement. The operational significance of this finding, as well as the recovery phenomenon seen in all cases, indicates the importance of continued research in this area. (auth) (STAR)

33821 (AD-681069) TRANSFER BY NORMAL AND CHRONIC FOCAL-HEAD IRRADIATED MONKEYS OF A SINGLE LEARNED DISCRIMINATION ALONG A PERIPHERAL CUE GRADIENT. McDowell, A. A.; Brown, W. Lynn (Texas Univ., Austin. Radiobiological Lab.). Feb. 1959. 4p. (SAM-59-18). CFSTI.

Nine normal monkeys, three monkeys with previous focal-head x irradiation of the posterior association areas, and two monkeys with previous focal-head irradiation of the frontal association areas were tested for transfer of a simple learned discrimination along a peripheral cue gradient. The results of the study demonstrated that there was no significant difference in performance between normal and chronic focal-head irradiated monkeys. There was a significant change in performance as a function of degree of spatial separation between the relevant discrimination and site of food reward. (auth) (TAB)

33822 (AD-681071) NARROWING OF ATTENTION IN RHESUS MONKEYS AS A CHRONIC EFFECT OF SUBLETHAL RADIATION. Overall, John E.; Brown, W. Lynn (Texas Univ., Austin. Radiobiological Lab.). May 1958. 7p. (SAM-58-27). CFSTI.

The subjects in this experiment were Macacu mulatta (rhesus) monkeys. Three groups, low dose irradiated, high dose irradiated, and control nonirradiated, were trained on a simple black-white discrimination. The results are interpreted to indicate a wider scope of attention in control and low dose irradiated subjects. These subjects attended to cues of position while they were learning the black-white discrimination, but high dose irradiated subjects indicated no such attention to the irrelevant cues of position. (auth) (TAB)

33823 (AD-681074) RUNNING WHEEL ACTIVITY OF RATS TESTED UNDER VARYING CONDITIONS OF FOOD DEPRIVATION THIRTY-THREE DAYS AFTER ACUTE EXPOSURE TO 1,050 R OF GAMMA RADIATION. McDowell, A. A.; Brown, W. Lynn (Texas Univ., Austin. Radiobiological Lab.). Mar. 1959. 4p. (SAM-58-143). CFSTI.

Four normal and five acutely γ-irradiated male Sprague-Dawley rats, all of the same age, were compared with respect to running wheel activity under four food deprivation schedules. The mean running wheel activity for the animals of the normal group over the four deprivation schedules was significantly greater than that for the animals of the irradiated group. Running wheel activity varied significantly with deprivation schedules. The interaction between groups and deprivation schedules was significant. A significantly greater gain in running wheel activity during the second than during the first 4-day period of total food deprivation was noted. (auth) (TAB)

33824 (AD-682903) THE ACUTE MORTALITY RESPONSE OF MONKEYS (MACACA MULATTA) TO PULSED MIXED GAMMA-NEUTRON RADIATIONS. Wise, D.; Turbyfill, C. L. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). June 1968. 29p. (AFRRI-SR-68-17). CFSTI.

The acute mortality response of the monkey (Macaca mulatta) to pulsed TRIGA reactor (mixed gamma-neutron) radiations was investigated to determine whether the LD50/60 differed significantly from that established with the same source at a dose rate of 20 rads/min. Radiations were delivered unilaterally in a pulse with a width of less than 50 milliseconds at half height. Exposures were Class B, nonuniform. The LD50/60 obtained was 375 rads, which did not differ significantly from the LD50/60 of 381 rads for this source at a 20 rads/min dose rate. Clinical response, survival times, and hematological, pathological, and bacteriological changes are reported. (auth) (USGRDR)

33825 (AD-684435) RECOVERY OF SHEEP AFTER WHOLE-BODY IRRADIATION: A COMPARISON OF CHANGES IN RADIOSENSITIVITY AFTER EITHER ACUTE OR PROTRACTED EXPOSURE. Page, Robert P.; Ainsworth, Earl J.; Taylor, James F.; Leong, George F. (Naval Radiological Defense Lab., San Francisco, Calif.). Nov. 25, 1968. 37p. (USNRDL-TR-69-4). CFSTI.

The kinetics of recovery of sheep in terms of time-dependent changes in radiosensitivity (LD50) have been evaluated as a function of dose rate and size of exposure to 60 Co gamma or 1 Mvp x rays. Although there were certain quantitative differences in recovery pattern, as related to both dose rate and size of the conditioning exposure, the basic pattern can be qualitatively described as consisting of three distinct phases. The first phase, lasting 5 to 10 days, consists of a shoulder or very slow recovery. This is followed in the 15 to 20 day postconditioning period by rapid recovery which proceeds to an overrecovery or radioresistance of LD50's considerably greater than normal (controls). The resistance was only a transient phenomenon and during the 24 to 30 day period the animals had returned to a more sensitive condition with LD50's slightly less than normal. This third phase appeared to remain at least as long as 75 days and may represent either a very slow recovery or the irreparable fraction. Changes in the survival time of decedents in the challenge LD50 studies appeared related to the recovery period. The mean survival times were shorter <20 day recovery studies and longer in those in the >20 day experiments. Speculation is offered as to physiological changes that might account for such a relation. (auth) (USGRDR)

33826 (AD-684436) HEMATOLOGICAL RESPONSE IN SHEEP GIVEN PROTRACTED EXPOSURES TO ^{60}Co GAMMA RADIATION. Still, Edwin T.; Taketa, S. T.; Ainsworth, Earl J.; Leong, George F.; Taylor, James F. (Naval Radiological Defense Lab., San Francisco, Calif.). Mar. 26, 1969. 23p. (USNRDL-TR-69-6). CFSTI.

The changes in the total leukocytes in sheep irradiated with ^{60}Co γ rays at a rate of 1.9 R/hr have been determined. After 50 R total exposure, maximum depression occurred 24 hours later. After 100 R or 175 R, maximum depression occurred within one hour. Recovery to control values was seen by 8 to 9 days for all three exposure groups. The recovery pattern for the circulating leukocytes was qualitatively the same for each of the three groups. An early lymphopenia was seen in all the groups, with recovery to the normal by 5 to 8 days. The percentage of neutrophils was greatly increased during the first 5 days. The data indicated that total leukocyte counts may not be a reliable means of predicting the exposure an animal sustains under protracted irradiation conditions. (auth) (USGRDR)

33827 (AD-685234) RESIDUAL INJURY IN THE ERYTHROPOIETIC SYSTEM OF SHEEP AFTER ^{60}Co GAMMA RADIATION. Ng, Harven; Leong, George F. (Naval Radiological Defense Lab., San Francisco, Calif.). Feb. 18, 1969. 29p. (USNRDL-TR-69-9). CFSTI.

Erythropoietic activity, as measured by ^{59}Fe uptake, was determined in nonirradiated sheep and in sheep surviving midlethal exposures to ^{60}Co radiation approximately two years prior to this study. A group of survivors of the midlethal exposure and sheep that received 50 R approximately 6 months previously were challenged with 170 R x irradiation during this study to determine the effects of this stressing exposure on erythropoietic activity. Nonirradiated sheep and those previously given 50 R were 2 to $2\frac{1}{2}$ years of age and survivors were 3 to $3\frac{1}{2}$ years of age at the time of this study. ^{59}Fe uptake in sheep surviving the midlethal exposure, when compared with ^{59}Fe uptake in nonirradiated sheep over four days following injection of the isotope, was significantly higher both in percent of the injected aliquot reappearing in the peripheral circulation and in the rate at which it reappeared. Although the survivors were 1 to $1\frac{1}{2}$ years older than the nonirradiated group at the time of this study, age differential was not considered to be responsible for the increased uptake observed. The data suggest that increased erythropoietic activity in sheep two years after milethal exposure may be due to a radiation induced aberration of the stem cell pool resulting in a sustained increase in proliferation of this compartment. (auth) (USGRDR)

33828 (BNL-13521) INFLUENCE OF THYMECTOMY AND EXTRACORPOREAL IRRADIATION OF BLOOD UPON BLOOD LYMPHOCYTES IN GOATS. Chanana, A. D.; Cronkite, E. P.; Joel, D. D.; Sipe, C. R. (Brookhaven National Lab., Upton, N. Y.). [nd]. 8p. (CONF-690409-1). Dep. CFSTI.

From 53rd Annual Meeting of the Federation of American Societies for Experimental Biology, Atlantic City, N. J.

Blood lymphocytes decreased following thymectomy in goats. At 57 weeks post thymectomy, the small lymphocytes in the blood appeared to be still decreasing with an approximate half-time of 60 weeks. This suggests that thymic cells in the recirculating pool of lymphocytes are long lived or that the thymus regulates the production of new lymphocytes in other tissues of the young adult goat. Whether blood lymphocytes would continue to decrease indefinitely after thymectomy remains to be answered. Extracorporeal irradiation of the blood (ECIB) using ^{137}Cs γ rays produced a decrease in lymphocytes in non-thymectomized and thymectomized goats. The ability of ECIB to induce a further fall in the numbers of blood

lymphocytes in thymectomized goats cannot be analyzed further as the relative proportion of thymic and non-thymic lymphocytes in the circulation is not known. This problem is further complicated by a lack of knowledge about the contribution to the blood lymphocyte recirculating pool by spleen, thymus, lymph nodes, and the bone marrow. The accelerated and more pronounced fall in the small lymphocytes during the first few days of ECIB in some thymectomized goats as compared to non-thymectomized goats may reflect the loss of mobilizable "thymic" lymphocytes from the thymic dependent areas in lymphoid organs. The blood lymphocyte recovery following ECIB was impaired in all thymectomized goats as compared to non-thymectomized goats. This finding most probably reflects a severe diminution in the readily accessible lymphocyte compartment in thymectomized goats. Immunological status of these goats has been tested so far. (C.O.)

33829 (CEA-CONF-1257) INFLUENCE OF TOTAL IRRADIATION AND THE VISUAL POTENTIAL IN ADULT RABBITS. Avargues, M. (Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires); Court, L. (Centre de Recherches du Service de Sante des Armees, Paris (France). Division de Radiobiologie); Laget, P. (Paris Univ. (France). Laboratoire de Physiologie Generale). [1968]. 2p. (In French). (CONF-690210-1). Dep.

From Conference on the Association of Physiologists, Poitiers, France.

Electrodes were implanted in the motor cortex of rabbits at the level of the hippocampus. Three months later visual stimulation was obtained by exposing the eyes to a flash every ten sec. The rabbits were given 400 and 600 rad of γ radiation, and results were recorded 30 min before irradiation and at regular intervals for five days following irradiation. With the 400 rad dose, maximum effects appeared at the second or third hr after irradiation and disappeared within a few days. With the 600 rad dose, the results were inconsistent. In some animals there was an increase in the latent period; in others, the results were similar to those obtained with the 400 rad dose. (H.L.W.)

33830 (NYO-3970-25) CELL PROLIFERATION STUDIES IN CONTINUOUSLY IRRADIATED MAMMALS: EFFECT OF AGE. Fabrikant, Jacob I. (Johns Hopkins Univ., Baltimore, Md. Dept. of Radiological Sciences). Apr. 30, 1969. Contract AT(30-1)-3970. 16p. (CONF-690501-1). Dep. CFSTI.

From 9th Annual Hanford Symposium on Radiation Biology of the Fetal and Juvenile Mammal, Richland, Wash.

It was demonstrated that the radiation effects in certain of the cell renewal systems (hemopoietic stem cells, semiferous epithelium, and thymus) in mice depend, in part, on the cell population structure and proliferative characteristics of the tissue at the time of exposure. The maintenance of cell proliferation and differentiation under the stress of γ and x radiation injury is governed, in part, by the homeostatic control mechanisms which regulate cell reproduction. Thus the kinetics of depopulation and recovery from radiation injury would depend on the integrity of the internal and external factors which determine the availability of normal stem cells, proliferating precursor cells, and possible feedback mechanisms, such as hormonal agents, regulating cell population size and differentiation. Since these factors change with age and particularly during the early period of growth and maturation of the animal, it would be expected that the radiation response would be affected by the age of the host and thus the cell population structure, and the extent of perturbations of the system by radiation. (C.O.)

33831 (ORO-2903-44) STUDIES IN THE USE OF IONIZING RADIATIONS AS STIMULI. Progress Report, June 1, 1968-May 31, 1969. Smith, James C. (Florida State Univ., Tallahassee. Dept. of Psychology). May 29, 1969. Contract AT(40-1)-2903. 12p. Dep. CFSTI.

Investigations were conducted on the use of x rays and γ rays as noxious unconditioned stimuli in conditioning aversions to preferred taste solutions. Effects of the circadian rhythm on radioinduced aversion to saccharin in rats were studied. Radioinduced aversion to sucrose solutions was studied using a bar press reinforcement. Gamma rays and x rays were used as a warning stimulus for subsequent shock to show that rats, monkeys, and pigeons elicit immediate responses on the onset of the ionizing radiation. Light, beta rays, and gamma rays were compared as effective stimuli to elicit either flight behavior or electrical responses from the visual system of the moth, Heliothis zea. (H.L.W.)

33832 (PHS-PUBL.-1809, pp 45-58) RADIATION ONCOLOGY AND PATHOLOGY LABORATORY. Telles, Norman C. (Bureau of Radiological Health, Rockville, Md.).

The Radiation Oncology and Pathology Laboratory focuses its research on the pathogenetic mechanisms involved in radioinduced tumors; morphological and biochemical approaches are used primarily. Brief summaries are presented of research on effects of age on x-radiosensitivity of rat thyroid; spontaneous lesions in a colony of Chinese hamsters injected with ^{131}I; radiation enhancement of SV 40 transformation in 3T3 and human cells; infectivity and transformation relations of uv-irradiated SV 40 virus; and ultrastructure of hepatomas in rats treated with radiation and ethionine. (C.O.)

33833 (PHS-PUBL.-1809, pp 89-104) PHYSIOLOGY AND BIOPHYSICS LABORATORY. Shore, Moris L. (Bureau of Radiological Health, Rockville, Md.).

Brief summaries are presented of the research projects conducted at the Physiology and Biophysics Laboratory. Areas under investigation are as follows: effects of microwave radiation on Chinese hamsters; hematopoietic changes associated with in utero irradiation of rats; in utero irradiation with high and low energy x rays at various dose rates; effect of x radiation and microwave radiation in vitro and in vivo on human and rat gamma globulins; and the isolation of Kupffer cells from rat liver and studies of cellular respiration during phagocytosis. (C.O.)

33834 (PHS-PUBL.-1809, pp 105-11) COLLABORATIVE RADIOLOGICAL HEALTH LABORATORY. Garner, R. John (Bureau of Radiological Health, Rockville, Md.).

Brief summaries of the research projects at the Collaborative Radiological Health Laboratory are presented. The experimental material, i.e., the cesarian-derived, barrier-maintained beagle colony is described and maintenance procedures are discussed. Results of studies on the long-term effects in the beagle of a single whole-body γ-ray exposure at different periods of development are also presented and discussed. (C.O.)

33835 (PU-2000(51)) AUTORADIOGRAPHIC INVESTIGATION OF BRAIN METABOLISM UNDER NORMAL, EXPERIMENTAL, AND PATHOLOGICAL CONDITIONS. Annual Progress Report, September 1, 1968-August 31, 1969. Altman, Joseph (Purdue Univ., Lafayette, Ind. Dept. of Biological Sciences). Contract AT(11-1)-2000. 17p. Dep. CFSTI.

A detailed histological and autoradiographic study of the development of the cerebellum from birth to adulthood was made in rats. The daily growth rate of the cerebellum as a whole and the growth pattern of the different layers of the cerebellar cortex were established using planimetry. With quantitative thymidine-^3H autoradiography, the sequential acquisition and differentiation of basket, granule, and stellate cells, and the chronology of the maturation of the different lobules in the cerebellar vermis and hemispheres were studied. The fate of multiplying cells located near the wall of the inferior horn of the lateral ventricle in rats injected with thymidine-^3H at 30 days of age, with survival after injection ranging from 1 hr to 180 days was also examined. It was established that the cells multiplying in this region move through the rostral migratory stream and reach the olfactory bulb in 6 days. The labeled cells then move between 6 to 20 days after injection from the subependymal layer of the olfactory bulb into the internal granular layer. With a single injection of thymidine-^3H, over 10% of the cells of the internal granular layers are labeled, which probably included granular neurons. This migratory stream is present in adult rats. Since the olfactory bulb does not grow in bulk in adult rats, this continuous addition of new cells suggests renewal of the cell population of this system. In a combined histological and autoradiographic study, the heads of 3-day old rats were irradiated with a single dose of 200 R x ray, and cell pyknosis was studied in different brain regions. It was established that migratory primitive cells and prospective migratory cells were killed in large proportion with this dose, whether mitotic or postmitotic. Relatively few of the stationary proliferating cells were killed with 200 R, and stationary differentiating cells were not visibly affected. This finding suggested that the cellular mechanisms responsible for migration, rather than damage to DNA was the principal cause of cell death after irradiation with 200 R. In a related study, the time course of cell death in 3-day old rats irradiated with a single dose of 200 R was determined, survival after irradiation ranging from 10 min to 5 days. Cell pyknosis became evident 4 hr after irradiation, with the maximal number of pyknotic cells seen 12 hr after irradiation. There was a reduction in pyknotic cells 24 hr after irradiation and by 48 hr the killed cells had disappeared. It was also observed that by the 4th day after irradiation the width of the external granular layer was normal or supernormal, suggesting that this proliferative zone had the capacity to reconstitute itself. In a subsequent systematic study, the developmental recovery of the external granular layer was examined in rats in which the cerebellum was irradiated daily with 200 R from the day of birth, with the number of exposures ranging from 1 to 10. It was found that the cell population of the external granular layer was drastically reduced

24 hr after irradiation with a single dose, and was subtotally destroyed after the second exposure. In animals irradiated with daily doses of 200 R up to 5 occasions, recovery of the external granular layer was evident 4 days after the last exposure and the extent of recovery was inversely related to the number of doses received. This study confirmed the previous observation that during this phase of development the proliferative matrix of the cerebellar cortex can be reconstituted. (auth)

33836 (UCSF-10-P-2-78) RADIATION REPAIR MECHANISMS IN MAMMALIAN CELLS. Cleaver, J. E. (California Univ., San Francisco. Lab. of Radiobiology). May 1969. Contract AT(11-1)-Gen-10. 36p. (CONF-690303-1). Dep. CFSTI.

From Symposium on the Biological Implications of the Nuclear Age, Livermore, Calif.

Mammalian cells use several biochemical mechanisms to repair or tolerate DNA damage. Breaks caused by x rays in the DNA chain are rejoined rapidly; damage to DNA bases caused by ultraviolet light is repaired by removal of the damage and synthesis of a replacement region. Only a small fraction of the damage caused by ultraviolet light (pyrimidine dimers) is excised, and this particular repair system may be inefficient in mammalian cells. A human hereditary disease, xeroderma pigmentosum, appears to be defective at the excision step of repair. Unexcised damage interferes with DNA replication such that newly synthesised strands contain numerous gaps; the number of gaps increases as a function of the amount of damage. The gaps are joined by a process which can be inhibited by caffeine. The correlation of a high incidence of cancer with defective repair in xeroderma pigmentosum indicates that unrepaired DNA damage may be implicated in some forms of carcinogenesis. (auth)

33837 (UR-49-1111) RADIATION EFFECTS: PERINATAL. SUMMARY. Casarett, George W. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). May 28, 1969. 21p. (CONF-690501-4). Dep. CFSTI.

From 9th Annual Hanford Symposium on Radiation Biology of the Fetal and Juvenile Mammal, Richland, Wash.

Studies of the development and survival of dogs, mice, rats, cattle, swine, and goats following γ- or x-irradiation during late fetal life to early puberty are reviewed. Data are included on the radiosensitivity of developing bone marrow, bones, brain, central nervous system, eyes, gonads, gastrointestinal tract, and thyroids in mammals. (48 references.) (C.H.)

33838 PRECONCEPTION IRRADIATION OF DAM AND COMPOSITION OF OFFSPRING. Hahn, E. W.; Heggeness, F. W. (Univ. of Rochester, N. Y.). J. Nutr., 98: 181-7(June 1969).

Whole-body irradiation of the female rat alters the ovulation response at next estrus. Number of ova shed can be predictable varied from 10 to 35 depending upon the dose and time in the estrous cycle it is administered. If bred, pregnancy is uneventful but litter size ranges from 2 to 18 pups, depending upon dose of radiation. The purpose of these experiments was to examine the effect of preconceptual irradiation and the number of pups per litter on the growth of the offspring. Fat content of newborn pups was not influenced by litter size or preconception irradiation. Total body nitrogen was 80% of control value in offspring of mothers given over 300 R with a maximal effect seen at 400 R. Nitrogen content was not related to litter size. Additional young were cross-fostered to unirradiated dams and then fed ad libitum. At 100 days nitrogen content of animals born of mothers administered up to 400 R was not different from control value, but was decreased to 90% of control value in offspring of females receiving 600 R. Growth potential appeared to be slightly but permanently modified by 600 R of preconceptual radiation. (auth)

33839 POSTPONEMENT OF MURINE RADIOGENIC LEUKEMIA BY MANIPULATION OF THE PRELEUKEMIC STATE. Ludwig, Frederic C.; Elashoff, Robert M.; Rambo, Oscar N. (Univ. of California, San Francisco). Proc. Soc. Exp. Biol. Med., 130: 1285-8(Apr. 1969).

The same radiation dose which enhances leukemogenesis if delivered to an unirradiated mouse counteracts leukemia development if given to a previously irradiated but not yet leukemic mouse. This indicates that the preleukemic interval between recovery from acute radiation injury and overt malignancy is radiosensitive and that it involves changes other than mere immune suppression. The theoretical optimum conditions of such manipulation are discussed, as well as its implications for the prophylaxis of radiogenic leukemia. (auth)

33840 THE EFFECT OF EPITHELIAL REMNANT AND WHOLE ORGAN GRAFTS OF THYMUS ON THE RECOVERY OF THYMECTOMIZED IRRADIATED MICE. Hays, Esther F. (Univ. of California, Los Angeles). Contract AT(04-1)-GEN-12. J. Exp. Med., 129: 1235-46(June 1, 1969).

Results are presented that suggest that thymus epithelial reticular cells are not effective in restoring the microscopic morphology of lymphoid tissues and their immunologic capacities. They function in recruiting precursors of thymus lymphocytes from the host animals to produce an organ that, after it becomes architecturally normal, can reconstitute the defective host. Intact thymus grafts in situ from 10 to 14 days, but not for shorter periods of time, were shown to result in a return toward normal of these two parameters. Evidence is offered to show that few dividing cellular components in the lymphoid tissue originate from the thymus remnant grafts, and that a minor cellular component is contributed by the intact grafts. These data support the concept that the structural and functional development of the lymphatic tissue in thymectomized animals is dependent on thymus lymphoid cells and/or their products, and that the epithelial-reticular cells do not have a direct action in peripheral lymphoid reconstitution. (auth)

33841 THE EFFECT OF ACUTE AND FRACTIONATED DOSES OF X RAYS ON THE GROWTH OF THE MOUSE TIBIA. Wells, A. B. (Guy's Hospital, London). Brit. J. Radiol., 42: 364-71(May 1969).

An exposure-response curve is given for the depression of growth of the mouse tibia after irradiation of one hind leg at three weeks of age with 250 kVp x rays. The mice were killed at about 40 weeks after irradiation, when the deficit was maximal, except for the 2,000 R exposure group killed at 12 weeks after irradiation. The curve is linear from 200 down to 1,000 R. (The 2,000 R point is well above the line although the standard deviation does touch the line. This shows up more using a logarithmic scale for these results.) The results for 50 and 100 R lie on a shoulder. There is no significant difference in response to fractionated exposures of 2 × 500 R, 5 × 200 R, or 10 × 100 R. The mean result in each group can be explained using the exposure-response curve for single exposures and measured values for the loss of response with age at irradiation. When total exposures of 2,000 or 1,000 R are given as two equal fractions, the efficiency is least when the fraction interval is six to 12 hrs, after which there is a partial recovery of efficiency that is more obvious after the smaller total exposure. An explanation is suggested on the basis of the observed depression and recovery of mitotic rate in the irradiated cartilage plate. (auth)

33842 EFFECTS OF X-IRRADIATION ON THE CELL POPULATION KINETICS IN A MODEL TUMOR AND NORMAL TISSUE SYSTEM: IMPLICATIONS FOR THE TREATMENT OF HUMAN MALIGNANCIES. Brown, J. M.; Berry, R. J. (Churchill Hospital, Oxford). Brit. J. Radiol., 42: 372-7(May 1969).

Using standard autoradiographic techniques following single or repeated injections of tritium-labeled thymidine, the cell cycle time of the cells of the normal epithelium of the hamster cheek pouch and of chemically induced squamous carcinomas in the pouch was measured by a variety of methods. The median cell cycle time of the proliferating tumor cells was 11 hrs, whereas that of the normal epithelial cells was 130 to 140 hrs. Following acute doses of either 500 or 1,000 Rads of x radiation, the generation cycle of the malignant cells was slightly elongated, while the normal basal cells of the epithelium suffered a 20 to 30% shortening of their cell cycle after these doses. The relevance of these data to the clinical situation is considered. (auth)

33843 BONE-REMODELING DYNAMICS FOLLOWING LOCAL X IRRADIATION. I. Bures, M. F.; Wuehrmann, A. H. (Univ. of Alabama, Birmingham). J. Dent. Res., 48: 376-84 (May-June 1969).

A multiple tetracycline labeling method was employed in determining the external bone-remodeling rates in locally exposed Sprague-Dawley male rats. An assessment of the abscopal effect of local radiation injury was also made. X radiation exposures of 4,500 and 9,000 R delivered to the middle segment of the rat tibia resulted in substantial external bone-remodeling disturbances. External remodeling, being the sum of endosteal and periosteal bone formation-resorption processes, was affected in two basically different ways: the periosteal apposition at the site of exposure decreased shortly after irradiation; and the endosteal apposition at the site of exposure increased. The decrease in periosteal apposition following direct exposure of the tibia was apparently counterbalanced by the endosteal apposition increase, which, in turn, resulted in relatively unchanged final total bone area. The effect on bone-remodeling dynamics occurred shortly after exposure and persisted for at least 45 days after radiation treatment. The exposure of the left-tibia diaphysis produced an abscopal effect in the periosteum of the corresponding area on the contralateral side. The exposure of the mandibular molar region produced an abscopal effect in the tibia diaphysis. This effect showed up primarily in the periosteum and depended primarily on the level

of radiation exposure. The abscopal effect seemed to differ from the direct effect inasmuch as the direct effect produced an increased endosteal apposition to counteract the decreased periosteal apposition, whereas the abscopal effect was characterized by a reduced periosteal apposition without a compensating increase in endosteal activity. (auth)

33844 X-RADIATION DAMAGE TO THE HYPOXIC CORE AND TO THE PERIPHERY OF A TUMOR: AN IN VIVO PILOT STUDY. Urtasun, Raul C.; Merz, Timothy (Johns Hopkins Medical Institutions, Baltimore). Radiology, 92: 1089-91(Apr. 1969).

The comparative radiosensitivities of the vascularized peripheral cells, and the cells from the necrotic center in a C_3HBA mammary adenocarcinoma were determined in mice, by injecting peripheral and necrotic central cells from x-irradiated tumors into healthy mice. Success or failure of the transplanted tumor cells (peripheral or central) was used as the criterion for determining x-radiosensitivity. No tumors developed in the mice injected with cells from the core of the irradiated tumors while all other injected mice developed tumors. (E.R.B.)

33845 THE EFFECT OF ONE EXPOSURE OF DIFFERENT PARTS OF THE BODY OF MACACA MULATTA TO X-RAY RADIATION ON ITS HEMOGRAM. Ma, Hsiu-ch'uan. K'o Hsueh Chi Lu, 4: 86-92(Feb. 1960). (In Chinese).

Monkeys (Macaca mulatta) were x-irradiated with doses of 50 to 600 R. Three days after exposure there was a decrease in the number of white blood cells. The decrease in the eosinophil count was in direct proportion to the x ray dose. The spleen showed no decrease in the lymphocyte count but a striking decrease in the neutrophil count. There was little change in the number of red blood cells, hemoglobin, platelets, or degenerated white blood cells. (auth) (JPRS)

33846 INACTIVATION OF STEM CELLS AFTER TRANSPLANTATION OF MIXTURES OF HAEMOPOIETIC OR LYMPHOID CELLS OF DIFFERENT GENOTYPES. Petrov, Rem V.; Manyko, Victor M.; Panteleev, Edward I.; Seslavina, Liya S. (Inst. of Biophysics, Moscow). Transplantation, 7: 165-75(Mar. 1969).

Transplantation of a mixture of hemopoietic or lymphoid cells from two genetically different mice into lethally γ-irradiated F_1 recipients results in a significant or complete inactivation of colony-forming units of the graft. The phenomenon was observed after transfer of a mixture of spleen or bone marrow cells from animals of two different genotypes: CBA + C57BL, A + CBA, A + C57BL, C3H + C57BL, CBA + (CBA × C57BL)F_1. The maximal inactivation occurred after transplantation of lymph node cells of one genotype mixed with spleen or bone marrow cells of another genotype. The use of non-syngeneic kidney cells or irradiation-inactivated lymphoid cells as one of the mixture components showed that inactivation of genetically foreign stem cells requires participation of viable lymphoid cells. The inactivation phenomenon was also detected by the Jerne method. The latter indicates that not only colony-forming cells but also immunocompetent precursors of antibody producers can undergo inactivation. (auth)

33847 EFFECTS OF ^{59}Fe ON BLOOD AND BONE MARROW OF RABBITS. Ward, Jimmy M.; Sommers, E. Blanche (Univ. of Oklahoma, Norman). J. Pharm. Sci., 58: 487-9(Apr. 1969).

The effects of ^{59}Fe on blood and bone marrow of rabbits were studied. Erythrocyte counts and leukocyte differential counts were made at three- and eight-day intervals while bone marrow differential counts were made after the 19th, 28th, and 40th days. Increased doses of ^{59}Fe increased the destruction of all blood cell types except lymphocytes. The ratio of lymphocytes in bone marrow also increased. (auth)

33848 POSTIRRADIATION CHANGES IN SERTOLI CELLS. Kochar, Nirmal K.; Bateman, A. J. (Univ. of Liverpool). J. Reprod. Fert., 18: 265-73(Mar. 1969).

Testes of mature male mice were x irradiated (300 kV) with a single dose of 1000 rad. Enumeration of the Sertoli cells at different intervals showed an increase in their number per mm^3 of tubule. However, with application of correction factors there was an immediate fall in the total Sertoli cells per testis which later stabilized at about half the pre-irradiation level. There was a reduction in the mean number of chromocenters per Sertoli cell, owing to a relative increase in the number of nuclei with one chromocenter, 14 days after irradiation. Labeled spermatocytes were transformed to restitution cells at the time that unirradiated spermatocytes would have produced spermatids. Seven days later the label appeared in spermatozoa. This implied that the restitution cells were not eliminated but were transformed to spermatozoa and the time-table of events was similar to that in normal spermiogenesis. No label appeared in Sertoli cells. The number of grains present in spermatocytes and restitution cells and spermatozoa was nearly the same, indicating no intervening nuclear division. The rate of recovery of labeled restitution cells and spermatozoa from irradiated spermatocytes confirmed that early spermatocytes (preleptotene and zygotene) are most sensitive and late spermatocytes (approaching diakinesis) are least sensitive to x rays. Thus the stages most susceptible to the killing effects of x rays are least sensitive in respect to retardation of development. (BBB)

33849 EXPERIMENTAL MYELOPROLIFERATIVE AND LYMPHOPROLIFERATIVE DISEASES OF SWINE. Howard, E. B.; Clarke, W. J.; Hackett, P. L. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Bibl. Haematol., No. 30, 255-62(1968).

From 3rd International Symposium on Comparative Leukemia Research, Paris, France. See CONF-670732.

A total of 665 pigs was placed on ^{90}Sr feeding at dose levels of 1 to 3.1 μCi per day while 270 untreated littermates served as controls. The most significant changes observed were proliferative or leukemoid responses involving the lymphoreticular and hematopoietic systems. It appeared that there was a time-dose dependency for the induction of these myelo-lympho-proliferative processes. Fifty pigs developed hemic or lymphatic disorders, 32 of which were myeloproliferative and 18 lymphoproliferative. Histological manifestations of the hemic and lymphatic disorders are described and discussed. (C.O.)

33850 A LEUKEMOGENIC FILTERABLE AGENT FROM RETICULAR CELL NEOPLASMS IN THE SJL/J STRAIN OF MICE. Haran-Ghera, Nechama; Kotler, M. (Weizmann Inst. of Science, Rehovoth, Israel). Bibl. Haematol., No. 30, 70-2 (1968).

From 3rd International Symposium on Comparative Leukemia Research, Paris, France. See CONF-670732.

Cell-free filtrates from spontaneous reticulum cell neoplasms were injected simultaneously into several-day-old thymus or spleen implants in thymectomized, x-irradiated (550 R whole-body exposure) mice. These filtrates, when injected into thymus implants produced lymphatic leukemia in 40% of the inoculated mice at an average latent period of 226 days; repeated serial cell-free filtrate passages of these induced lymphatic leukemias, and when injected into the thymus implants, revealed a similar activity, producing lymphatic leukemia in 30 to 50% of the inoculated mice at an average latent period of 180 to 210 days. The same cell-free filtrate preparations from spontaneous reticulum cell neoplasms, when injected into spleen implants in thymectomized irradiated hosts, shortened the latency period of reticulum cell neoplasm development; this yielded a 60% incidence at an average latent period of 280 days as compared with 290 days in the control group. Control mice developed leukemias within the range of the spontaneous incidence of tumors; 10 to 18% of the mice developed myeloid leukemia due to irradiation. (C.O.)

33851 CHANGES IN HEMODYNAMICS IN ACUTE RADIATION SICKNESS. Vycichl, J.; Kos, J.; Jurkovic, V. (Purkyne Military Medical Research and Postgraduate Schooling Inst., Hradec Kralove, Czech.). Cas. Lek. Cesk., 108: 416-21(Mar. 28, 1969). (In Czech).

Hemodynamic changes in dogs under thiopental anesthesia were investigated in intact dogs, and in dogs exposed to 300 R and 600 R doses of irradiation before and on the 3rd, 6th, and 14th days after exposure. After irradiation with 300 R no significant changes were found with the exception of a decrease in the systolic pressure on the 14th day after irradiation. Radiation doses of 600 R resulted in a significant decrease of blood pressure in the systematic and pulmonary circulation and at some intervals also changes in total peripheral resistance, total pulmonary resistance, and the output of the right and left ventricles. (JPRS)

33852 FORM PERCEPTION AND PATTERN REPRODUCTION BY MONKEYS. Medin, Douglas Lee. Vermillion, S. D., Univ. of South Dakota, 1968. 78p.

Thesis.

Four experiments tested pattern perception of monkeys by employing a method of reproduction and relating parameters of patterns to how easily they were reproduced. Patterns of Light-on, Light-off were presented in a 4 × 4 matrix of cells. Subjects were five old, four middle-aged, and two old irradiated Rhesus monkeys. Patterns were exposed to Ss for a certain interval; then, after a predetermined delay, Ss were required to respond to each previously lighted cell in the matrix (i.e., to reproduce the pattern). The first experiment employed one lighted cell per trial; the second, two lighted cells; and the third and fourth experiments, four lighted cells. The effects of position of the lights within the matrix, their Sides, dispersion (Variance), and symmetry were assessed. The more isolated (i.e., few neighboring cells) a single

light was, the easier it was to reproduce and this effect increased with longer delays. Two-light patterns were best reproduced when they were far from each other (thus occupying more isolated cells) and horizontally separated from each other. Successful performance was inversely related to the number of sides in 4-light patterns while directly related to the Variance (dispersion) of the lights. Generally, these findings were qualitatively similar to those found with human beings under comparable conditions. Contrary to this trend was the observation that symmetrical patterns were no more easily reproduced than asymmetrical patterns. In every experiment, as delay increased, performance decreased. The radiation survivors were grossly inferior to the other monkeys. However, one cannot generalize from this finding because the irradiated Ss had been isolated for their poor performance by a selective radiation death. The old animals performed worse than the middle-aged monkeys on the longer delay intervals in spite of evidence that they had attended to the patterns as well as the middle-aged Ss. The similarity between this and age-related short-term memory deficits in humans was discussed. (Diss. Abstr.)

33853 STUDIES OF THE RELATIVE BIOLOGICAL EFFECTIVENESS RBE OF 15-MeV NEUTRONS ON CATARACT DEVELOPMENT. Graul, E. H.; Neubauer, H.; Ruether, W.; Jacobi, K. W.; Kovacs, G. (Philipps-Univ., Marburg, Ger.). Arch. Klin. Exp. Ophthalmol., 176: 206-12(Dec. 6, 1968). (In German).

In 6-month-old rabbits the RBE of 15-MeV neutrons and ^{60}Co γ radiation in cataractogenesis was compared. Doses of 750 rad for neutrons and 1500 rad for γ rays were used. Opthalmoscopic and slit-lamp examinations were made periodically to follow the development of cataracts. Lens opacities were noted 3 to 10 months later for both types of radiation. The first opacities appeared 1 month earlier (at 90 days) with the neutron irradiation, but most of the animals developed opacities by 270 days in the 2 groups of 20 rabbits each. The RBE for neutrons as compared to γ rays was considered to be 2, in view of the fact that the neutron dose was twice as high and gave roughly the same effect. Further progression of the opacities to cataract is described. After 15 months all of the 40 rabbits showed completely opaque lenses. Other changes, such as conjunctivitis, blepharitis, keratitis, and depilation, were more frequent in the neutron-treated animals. (BBB)

33854 SOME EFFECTS OF LASER UPON THE BONES. Kolar, J.; Babicky, A.; Blabla, J. (Karls-Univ., Prague. Institut fuer Radiotechnik and Elektronik, Prague). Experientia, 25: 365-6(Apr. 15, 1969).

The biological effects of lasers upon the bone tissue of rats were investigated using ^{45}Ca tracer techniques. Male Wistar rats, weighing 120 to 130 g, were subjected to 3 laser pulses from a CO_2 laser, working in the IR spectral area with $\lambda = 10.6$ μm. After 4, 11, 18, 33, 46, 60, 74, and 102 days post-irradiation, animals were injected with 20 μCi of ^{45}Ca-labeled $CaCl_2$ and then killed 48 hr later. The bones were investigated chemically and dosimetrically for calcium content. The uptake of ^{45}Ca in irradiated rats at three weeks decreased considerably and increased considerably at 8.5 weeks; these results were observed in both irradiated and non-irradiated bone tissue of the legs. It was concluded that possible harmful effects of laser radiation are not negligible in relation to cosmetic surgery with lasers. (C.O.)

33855 CELL POPULATION KINETICS AND AGING WITH SPECIAL REFERENCE TO EFFECTS OF TEMPERATURE AND RADIATION ON CELL RENEWAL SYSTEMS IN FISH. Egami, Nobuo (National Inst. of Radiological Sciences, Chiba, Japan). Jikken Keitaigakushi, 21: 366-78(Dec. 1967). (In Japanese).

Cell population kinetics in cell renewal system is reviewed. Recent development of new techniques with isotopes and autoradiography has catalyzed study of kinetics of cellular proliferation. After general explanation of intestinal epithelium, hematopoetic tissue, and gonads in vertebrates, a part of results of recent experiments with fish are reported. In the fishes, Oryzias latipes and Carassius auratus, proliferation of cells is inhibited and number of total cells in the cell renewal system decreases following irradiation. Furthermore, the rate of the cell population change is dependent on temperature. Cell cycle and life span of the cells are longer at low temperature than those at high. On the basis of these results, importance of cell population kinetics in some biological problems is pointed out. (auth)

33856 CARDIAC OUTPUT AND ITS DISTRIBUTION IN THE TERMINAL STAGE OF THE GASTROINTESTINAL IRRADIATION SYNDROME ("RADIATION SHOCK"). Janossy, Gy. (Univ. Research Team of Medical Radiology, Budapest). Acta Med. Acad. Sci. Hung., 26: 23-9(1969).

The terminal phase of the gastrointestinal irradiation syndrome is similar to that in shock induced by injury, dehydration, or hemorrhage. Studies were made of cardiac output and peripheral resistance of individual organs in the terminal stage of gastrointestinal irradiation syndrome and the findings were compared with the changes occurring in other types (tourniquet, dehydration, hemorrhagic) of shock. Male Wistar rats were given a total-body x-irradiation dose of 1500 R and examined 72 hr later. Cardiac output in the control animals was 34.4 ml/min/100 g, as against 8.8 in those with irradiation shock. The respective values of mean arterial pressure were 127 vs 75.5 mm Hg. Calculated on this basis with reference to 100 g body-weight, total peripheral resistance (TPR) had more than doubled, rising from 290 to 643 dyne sec/cm^5. Cardiac output fractions for the individual organs showed a significant increase in the adrenal (319%), pulmonary (256%), hepatic (219%), and cardiac (198%) fractions as compared to the controls (100%). Correction of these values was necessary because the weight of individual organs was affected by irradiation. The most severely impaired organs shared a small fraction of cardiac output. Blood supply (corrected for weight changes) of the small intestine fell to 16.5%, of the skin to 13.7%, and of the spleen to 10.2%. Small-intestinal flow 72 hr after irradiation did not exceed 10% of the control value if referred to the whole organ; and flow in the spleen was as low as 2%. In consideration of the fact that in the terminal stage blood pressure was ~50% of its original value, TPR for heart and adrenals was in the control range. Kidney, carcass, stomach, and large intestine showed a 2-fold increase in TPR, whereas the increase in the resistance of the small intestine, skin, and spleen was disproportionately high. (BBB)

33857 PARTIAL MASCULINIZATION OF GENETIC FEMALE CHICKENS (GALLUS GALLUS) AFTER INCORPORATION OF ^3H-THYMIDINE DURING THE PERIOD OF OOGENESIS. Callebaut, M. (Studiecentrum voor Kernenergie, Mol, Belgium). Experientia, 25: 435-6(Apr. 15, 1969).

Six female chicks that survived treatment with 8 or 9 successive applications (every 8 hr) of 50 μCi ^3H-labeled thymidine were reared to the age of 7 to 8 mo. At the age of 4 to 5 mo, two of them showed initial signs of masculinization. At the age of 8 mo, typical male comb, gills, and ear lobes could be seen, together with glossy oblong feathers on the neck. The remaining parts of the body seemed to have a normal female appearance. One of the two chickens was able to crow. Gross and histological examination of the genital tract revealed abnormal ovaries; the reason for the masculinization was not found. (C.O.)

33858 THE THRESHOLD OF THE RETINA TO DAMAGE BY ARGON LASER RADIATION. L'Esperance, Francis A. Jr.; Kelly, Gordon R. (Columbia-Presbyterian Medical Center, New York). Arch. Ophthalmol., 81: 583-8(Apr. 1969).

Retinal lesions in rabbits and monkeys produced by various power levels of Ar laser radiation were examined and the threshold dose was determined. The Ar laser used had the capability of producing 1.5 w of radiation. The full beam potential was utilized that included 8 transitions ranging from 4579 to 5145 Å. The predominant wavelengths, 4880 and 5145 Å, comprised 90% of the power output. Power levels between 100 and 500 mw exit energy from the laser and the 4880 Å transition was considered to be the spectral line with the greatest power. The energy necessary to create a threshold visible retinal-lesion after a 1-hr observation period was calculated utilizing a 50% P histogram. Energies required during 2, 4, 10, and 20 sec exposure intervals or image diameters of 105 μ (monkeys) and 115 μ (rabbits) were determined. The incident corneal energy prior to impingement upon the contact lens and the retinal energy and power density after passage through the contact lens were also noted. (BBB)

33859 SKELETAL MALFORMATIONS IN MICE AFTER FRACTIONATED X RADIATION TO DIFFERENT HEAD PHASES OF THE EMBRYONIC DEVELOPMENT. Konermann, Gerhard (Univ., Freiburg i. B.). Strahlentherapie, 137: 214-30(Feb. 1969). (In German).

The external development damage to mice embryos after daily fractionated x irradiation was studied and the correlation between the appearance of skeletal damage and morphological irregularities was investigated. The relative frequency from both kinds of damage was highly correlated to each other after uniform treatment, although skeletal malformations predominated in their absolute frequency after stronger insults. Regarding the dose-dependence of the lesions, a characteristic threshold for the external changes was investigated. This was reflected in the respective incidence of damaged bone structures: although strongly modified by the choice of the irradiation period, the percentage of fetus with unaltered skeleton remained at a plateau up to considerable high total doses. This was followed by a gen-

eral breakdown of normal growth processes. The ratio of the observed external changes and of the skeletal malformations as well as the effectiveness of acute and fractionated insults until time of birth was discussed. There seems to be a mutual interference of primary radiation damage and effects of intrauterine selection as well as sensitization and regulative activity of the tissue according to its degree of differentiation. (tr-auth)

33860 STUDIES ON COMBINATION INJURIES. PART 12. SERUM PROTEIN CHANGES IN RATS INJURED BY WHOLE-BODY IRRADIATION AND OPEN SKIN WOUNDS. Messerschmidt, Otfried; Klemm, Dieter; Heppeler, Gerlinde (Univ., Freiburg i. B.). Strahlentherapie, 137: 204-13(Feb. 1969). (In German).

Rats were whole-body-irradiated with 640 R, others received one or three open skin wounds, and others received both combined, i.e., an open skin wound 2 or 8 days after irradiation. In all these rats the serum proteins were followed with electrophoresis. A decrease was found in the total amount, especially of the albumin and gamma-globulins. After combined lesions, these changes were much more pronounced, more than after irradiation or skin wounds alone. (tr-auth)

33861 CORRELATION BETWEEN THE SYNTHESIS OF DNA AND HISTONES IN POLYOMA VIRUS-INFECTED MOUSE EMBRYO CELLS. Shimono, Hideyo; Kaplan, Albert S. (Albert Einstein Medical Center, Philadelphia). Virology, 37: 690-4(Apr. 1969).

The synthesis of DNA and histone in x-irradiated mouse embryo cells following infection with polyoma virus was investigated. It was found that infection with this virus stimulated the rates of synthesis of histone as well as DNA, and that there was a correlation between the degree of stimulation of the synthesis of these two macromolecules by infection. (E.R.B.)

33862 CHANGES IN THE CIRCULATION OF THE MUCOSA AND MUSCLE LAYERS OF THE SMALL INTESTINE OF THE RAT AFTER SUPRALETHAL RADIATION. Zseboek, Zoltan B.; Janossy, Gyoergy; Meszaros, Iren F. (Medizinisch-Radiologische Forschungsinstitut, Budapest). Strahlentherapie, 137: 177-82(Feb. 1969). (In German).

The circulation fractions of the mucosa and muscle layer of the intestine were studied by means of the ^{86}Rb extraction technique, 4, 24, and 48 hrs after whole-body irradiation with 1500 R. The observed fractions were related to the DNA content of the portions studied. The results show that four hrs after the irradiation the enhancement of circulation of the mucosa was more pronounced than the one that resulted from an increase of the cardiac output and tissular edema of mucosa develops at the same time. After 24 hrs the organ fraction referred to the DNA content of the duodenum was considerably increased, whereas a similar hyperaemia was only found in the middle and distal segment after 48 hrs. This circulatory increase is a secondary phenomenon resulting from the fact that the lesion of the capillary system during the observation period was not as severe as the loss of epithelial tissue. These hyperaemic phenomena can result in an increase of transudation. (tr-auth)

33863 STUDIES ON BONE CALCIUM METABOLISM AFTER LOCAL X RADIATION. PART IX. GENERAL REACTIONS DURING PREGNANCY. Babicky, Arnost; Kolář, Jaromir; Ostadalova, Ivana; Parizek, Jiri (Isotopen-Laboratorien, Prague. Physiologische Institut, Prague. Karls-Univ., Prague). Strahlentherapie, 137: 170-6(Feb. 1969). (In German).

Local irradiation with 2000 R in female rats provoked general modification of calcium metabolism in the skeletal system. During pregnancy and lactation period these reactions were less pronounced. After the lactation period they were more pronounced. In the newborn no particular differences were found for mineral content of bones. During pregnancy, radiation effects on metabolism were reduced in order to preserve the conditions for a normal development of the progeny. (tr-auth)

33864 THE EFFECT OF ^{60}Co IRRADIATION ON BONE IN DOGS. PART I. MATURE BONE. Rissanen, Pentti; Rokkanen, Pentti; Paatsama, Saki (Univ. Central Hospital, Helsinki. Coll. of Veterinary Medicine, Helsinki). Strahlentherapie, 137: 162-9(Feb. 1969).

The effect of ^{60}Co irradiation on bone tissue of adult dogs was studied by histological, histochemical and OTC labeling methods, by autoradiography and microradiography. Single doses of 500 rad, 1000 rad and 4000 rad were used. The dogs were sacrificed four days, two weeks, and two months after irradiation. Four days after irradiation with all of the doses used, the bone spaces were poor in cells; after irradiation with the largest dose, the bone spaces were entirely acellular. Two weeks after irradiation the density of the bone trabeculae was decreased, due to a reduction in mineral content. At the same time the cancellous spaces and the surface of the diaphysis exhibited poorly mineralized areas, interpreted as a sign of regeneration. This phenomenon was also observed two months after irradiation. The articular cartilage showed degenerative changes, in particular after irradiation with the largest dose and after the longest time of observation. It seems obvious that mature cartilage and bone, particularly with regard to their microstructure, are not as radioresistant as has generally been assumed. (tr-auth)

33865 CHANGES IN THE NATURAL RADIORESISTANCE OF THE MOUSE AFTER HYPOXIA OF SEVERAL DAYS' DURATION: OXIDATIVE METABOLISM FOLLOWING RADIATION AND HYPOXIA. Tribukait, Bernhard (Karolinska Institutet, Stockholm). Strahlentherapie, 137: 187-95(Feb. 1969). (In German).

Variations of radiosensitivity following 10 days in hypoxia corresponding to 6000 m altitude were studied. The effect of irradiation and hypoxia on the oxygen metabolism was studied. After irradiation of normal mice with 600 to 2000 R (telecobalt) the oxygen consumption decreased by 15 to 60% depending on the dose and the time elapsed after irradiation. Immediately after irradiation and up to seven hrs, the oxygen consumption decreased, it was normal between 14 and 24 hrs, but maximally depressed after about 3 days. After sublethal doses it was depressed even after three weeks. After lethal doses, it remained on a plateau between the 5th and 10th day and decreased further until death at the 15th day. On changing from 25° to 18°C the consumption increased by 40%, even after irradiation with 2000 R. From the end of the hypoxia until 6 hrs later, when the radiation sensitivity was greatest, the oxygen consumption was about 10 to 20% below normal; it returned to normal gradually after 48 to 72 hrs. The effect on animals irradiated 72 hrs after hypoxia, at the time of reduced radiosensitivity, was similar to that of normal animals irradiated with sublethal doses. There was no direct relationship between the overall oxygen metabolism and the radiosensitivity variations after hypoxia. (tr-auth)

33866 LUMINESCENT AND MICROSCOPIC STUDY OF THE MARROW IN RATS IRRADIATED WITH X-RAY AND FAST NEUTRONS. Dolgorukova, N. I. Fiziol. Zh., Akad. Nauk Ukr. RSR, 14: 402-3(May-June 1968). (In Ukrainian).

Results are given of luminescent and microscopic studies of bone marrow in rats irradiated with x rays and fast neutrons. Data obtained 3 and 6 hr and 1, 4, 8, 12, 16, 20, 24, 30, 60, 90, and 180 days following the exposure are analyzed. (R.V.J.)

33867 EFFECT OF LASER EMISSION ON THE SKIN OF THE NECK AND LARYNGEAL TISSUE OF ALBINO RATS. (COMMUNICATION I). Kolomichenko, A. I.; Pokotilenko, A. K.; Timen, G. E.; Zhelyazo, N. S. Zh. Ushnykh Nosovykh Gorlovykh Bolez., No. 6, 40-7(1968). (In Russian).

Histological studies were made of the skin of the neck and underlying tissues, cartilage, and mucous membranes of the larynx of rats subjected to radiation of a laser ruby, operating at wavelength of 6943 Å, and a neodymium laser, at a wavelength of 10,600 Å, with energies of 10 to 70 J per pulse. Data are presented for results of acute experiments conducted on 143 animals. Microscopic examinations of the skin, larynx, and esophagus revealed changes on the skin only. The changes depended on the energy and number of pulses, and were characterized by coagulation necrosis of the surface layers of the skin. Deep-lying dermal layers were dystrophic. Direct irradiation of the laryngeal cartilage was attended by coagulation necrosis with prolapse of necrotic masses. Hyperemia and focal hemorrhages occurred in the mucous membrane and muscle of the larynx adjoining the inner surface of the irradiated cartilage. Irradiation of the mucous membrane of the larynx through a laryngeal fissure, caused coagulation in the radiation site. On the periphery, the coagulation phenomena gave way to disorganization of the mucous membrane and dystrophy. (BBB)

33868 DEVELOPMENT OF ORTHOTOPICALLY TRANSPLANTATED MALE GERMINAL CELLS IN THE GOLDEN HAMSTER. Skowron, S.; Walknowska, Janina; Maron, K. (Dept. of Experimental Zoology, Krakow). Folia Biol. (Krakow), 16: 323-7(1968).

The growth of allogenic spermatogenic tissues following transplantation into the testes of young male hamsters made permanently sterile by exposure to a dose of 400 R x radiation was studied. The testicles of the host were examined cytologically at various times from 13 days to four months following transplantation of spermatogenic tissue. The spermatogenic cells did not develop when injected outside the seminiferous tubules. Following irradiation the sterile seminiferous tubules were devoid of germinal cells and showed signs of atrophy. Injection of spermatogenic tissue caused changes in the supporting cells of the tubules; these

developed the appearance of Sertoli cells. It was concluded that the normal structure of the seminiferous tubules depends upon the influence of both the germ cells and the supporting cells. (C.H.)

33869 SOME FUNCTIONAL AND MORPHOLOGICAL CHANGES OF THYROID GLAND AND HYPOPHYSIS IN RATS IRRADIATED WITH FAST NEUTRONS. Antipov, M. V. Fiziol. Zh., Akad. Nauk Ukr. RSR, 14: 399-400(May-June 1968). (In Ukrainian).

Functional and morphological changes in thyroid gland and hypophysis were studied in 56 rats irradiated by 200 R doses of fast neutrons. It was revealed that at early stages of exposure to fast neutrons the thyroid gland undergoes considerable destructive changes while frontal hypophysis and relation between hypophysis and thyroid gland are not affected. (R.V.J.)

33870 IMMEDIATE TRANSIENT EFFECTS OF IONIZING RADIATION ON SELECTED VERTEBRATE PHYSIOLOGICAL SYSTEMS. Leith, John Thayer. Boston, Boston Univ., 1967. 173p.

Thesis.

The etiology of functional changes induced by radiation in vertebrate physiological systems was studied using several different experimental procedures. To ascertain radiation effects on a self-regulating vascular bed (cerebral vasculature), the intracranial temperature response of rabbits to acutely administered, high doses of x irradiation (250 kVp) was studied using chronically implanted semi-micro thermistor probes. Two different dose-rates (370 and 270 R/minute) and total dose combinations (9 and 12 kR) were used. A biphasic temperature increase was seen, with the initial increase from 0.8 to 1.1°C (maximum rate 0.01°C/minute), with a duration of 70 to 90 minutes. Brain temperature then returned to preirradiation levels. A second temperature increase was seen 150 to 200 minutes post-irradiation (0.7 to 0.9°C). This latter increase correlated with epileptiform seizures. Findings suggest that transient changes in cerebral blood flow and neural metabolism are associated with gross functional neurological changes seen following head irradiation. A cardiovascular sensory receptor system was studied with 15 kVp irradiation (4800 R/minute) of surgically exposed carotid sinus in rat, cat, dog, and rabbit. Responses were measured indirectly by alterations in respiratory and cardiac activity. A slight, transient respiratory depression in rats, and transient bradycardia in cats, dogs, and rabbits was seen. Bradycardia was also observed following proton (95 MeV) irradiation of carotid sinus in dogs. Direct proton irradiation of medullary centers produced no effect. Findings indicate that some cardiovascular immediate responses may be mediated via chemo- or baroreceptors. However, it is not clear how these are initiated. To determine if autonomically innervated smooth muscle required intact neural circuits for production of a radiation induced physiological response, small intestine and uterus of guinea pig was irradiated (15 kVp; 80 R/second) in vivo (closed circuit) and in vitro (open circuit). Both in vivo and in vitro uterus and intestine displayed an immediate transient increase in tonus following irradiation, of short duration which could be evoked in successive exposures. There were slight differences in latency between in vivo and in vitro preparations. It is clear that intact neural circuits are not necessary in this radiation response. Although local axon reflexes might account for observed changes, findings of other investigators suggest that this is improbable. Results strongly suggest that changes in smooth muscle state are mediated by release of bound neurohumoral agents. The cardiac response of anesthetized and doubly pithed frogs was analyzed after local irradiation (15 kVp; 80 R/second). The heart preparations in both showed a transient bradycardia that seemed to be dose-dependent, and was maximally shown by the first irradiation exposure, again with slight differences in latency between the two preparations. Results suggest that ionizing radiation may directly affect cardiac tissue, again possibly by release of bio-active chemicals. Radiation evokes immediate transient physiological changes in a number of autonomically innervated structures. Although a direct effect on a receptor was demonstrated, experiments on heart, intestine, and uterus strongly suggest that many responses are mediated by the release of bound neurohumoral agents. It was also shown that changes in brain metabolic or vasomotor activity both precede and accompany the convulsive phase of the radiation induced acute central nervous system syndrome. (TSS) (Disser. Abstr.)

33871 A COMPARATIVE STUDY OF THE LEUKEMOGENIC EFFECTS OF ^{90}Sr AND X-RAYS IN MICE. Ito, T.; Yokoro, K.; Ito, A.; Nishihara, E. (Hiroshima Univ., Japan). Proc. Soc. Exp. Biol. Med., 130: 345-50(Jan. 1969).

The leukemogenicity of ^{90}Sr was studied in comparison with that of fractionated whole-body x irradiation in the low-leukemia ICR/JCL strain of mice. Fractionated total-body x irradiation of 680 R yielded leukemia in 77.3% of mice, of which all but one were of thymic origin. A single intraperitoneal dose of 1.0 μCi/g of body weight of ^{90}Sr also had a high leukemogenic effect (61.8%). The ^{90}Sr-induced leukemias were cytologically of lymphoblastic, reticulum cell, or stem cell type, not of thymic origin. No myeloid leukemia occurred in these mice. Thymectomy inhibited the leukemogenic effect of total-body x irradiation as reported by others, while the induction of leukemia by ^{90}Sr was not inhibited by thymectomy. It is postulated that x irradiation produces progenitors of leukemic cells in bone marrow or spleen, and these cells migrate into the injured thymus where they proliferate, while the similar progenitor cells can be produced in bone marrow by direct effects of ^{90}Sr. As grafted lymphomas they migrate into lymphoid and other tissues but not preferentially into the thymus. Three cases of leukemia induced by ^{90}Sr and two cases by x rays were transmitted by presumably cell-free extracts. It is suggested, therefore, that a viral factor may take part in the leukemia induction by ^{90}Sr as it does in induction of leukemia by x rays. (auth)

33872 SOME PECULIARITIES OF CHANGES IN SPECIFIC GRAVITY OF HEALTHY BLOOD AND ITS SERUM IN RABBITS AFTER X-RAY RADIATION. Boiko, V. I. Fiziol. Zh., Akad. Nauk Ukr. RSR, 14: 400-1(May-June 1968). (In Ukrainian).

Changes in specific gravity of blood and blood serum were studied in 28 rabbits weighing 2.5 to 2.7 kg and exposed to 300 to 600 R doses of x radiation. Results are analyzed. (R.V.J.)

33873 HEALING OF HOMOPLASTIC BONE CHIP IRRADIATED WITH A RADIUM BOMB. Kosinka, E.; Horn, V.; Caha, A. Beitr. Orthop. Traumatol., 14: 565-6(Oct. 1967). (In German).

In studies on white Wistar rats, cortical bone chips preserved and lyophilized briefly and for long durations in absolute alcohol were irradiated with sealed radium sources in increasing doses. The healing of these chips was evaluated macro- and microscopically. (tr-auth)

33874 HISTOPATHOLOGICAL STUDIES OF CHRONIC RADIATION INJURIES OF THE SKIN. Okushima, Jintaro (Keio Univ., Tokyo). Keio Igaku, 45: 535-49(Nov. 1968). (In Japanese).

Chronic changes of the irradiated skin were observed macroscopically in 18 cases and also microscopically in accordance with the irradiation dose and the time after the irradiation. The results are as follows. The grading of radiation injuries of the skin is somewhat proportional to the radiation dose. Epidermal atrophy and proliferation of melanophores in the basal layer of epidermis were seen within several days after irradiation. These recovered in time. Several months after irradiation, hypertrophy and hyperkeratosis of the epidermis were observed, and in the subcutaneous tissue infiltration of round cells, increase of melanophores, hyalinization, teleangiectasis, infiltration of spindle cells and atrophy of sweat glands were also presented. A long time after irradiation (more than 5 years) strong hypertrophy, hyperkeratosis and also parakeratosis in the epidermis were the predominant changes. (NSA of Japan)

33875 THE PATHOGENESIS OF FETAL FATTY LIVER INFILTRATION AFTER WHOLE-BODY X IRRADIATION OF PREGNANT RATS. Haude, Wolfgang (Friedrich-Schiller-Univ., Jena, Ger.). Wiss. Z. Friedrich-Schiller-Univ., Jena, Math.-Naturwiss. Reihe, 17: 64-6(Jan. 1968). (In German).

Effects of a single whole-body dose of 800 R of x irradiation given between days 19 and 22 of pregnancy on liver concentrations of free and esterified cholesterol, tryglycerides, and various phosphatides in fetal and maternal rat livers were studied. Marked increases in liver triglycerides up to 4-fold normal 24 hr after irradiation were measured. Fatty acid synthesis was studied in vitro with ^{14}C-labeled acetate in fetal liver slices obtained 24 hr after whole-body irradiation. There was no increase in triglyceride synthesis, or in phosphatide synthesis as measured by incubation of the liver slices with ^{32}P. There was a marked increase in free fatty acids in maternal serum within 4 hr after whole-body x irradiation with a dose of 800 R. It was concluded that this increase was the cause of increased fatty acids observed in the fetal serum. Triglyceride increases observed in fetal livers after irradiation may have resulted from transfer of triglycerides from mother to fetus. The increase in fatty acids in all fetuses amounted to only about 10% of the increases observed in the maternal livers. (BBB)

33876 DEGENERATION AND REGENERATION OF CUTANEOUS NERVES IN THE HEALING PROCESS OF INCISED WOUNDS IN CONNECTION WITH ACUTE RADIATION SICKNESS. Serdyukov, G. I. (Kiev Medical Inst. Kiev Inst. for advanced Training of Physicians). Vrach. Delo, No. 2: 67-70(1968). (In Russian).

Acute radiation sickness was produced in 97 dogs with a single dose of 300 R. On the day of irradiation dogs in the first series received a straight wound 4 to 6 centimeters long on the external surface of the hip and in certain cases on the dorsum nasi. Dogs in the second series received similar wounds 20 days after irradiation, i.e., at the climax of radiation sickness. Dogs in the third series received the wound after 60 days, i.e., in the period of clinical recovery. The dogs were not treated, and material for histological examination was taken from the animals in each series 3, 7, 15, 20, 30, and 60 days after the operation. It was shown that changes in the peripheral nervous system of the skin in the region of the straight wound were most sharply pronounced and qualitatively most varied when the wound was made in the period of the climax of radiation sickness. In this case three to seven days after the wound was made its walls showed substantially more nerve fibers undergoing disintegration than in the control and the first and third series of experiments. Axons located a significant distance from the wound that were not directly injured by the incision were destroyed as well as those affected by the neurotomy. In the irradiated animals the process of degeneration of nerve fibers progressed rapidly, and the products of this disintegration were slowly liquidated. Whereas in the control animals this process was almost completely terminated two weeks after the wound was made, in the dogs of the first and third series it lasted up to 20 days, and in the animals of the second series up to 30 days. Regeneration of nerve fibers and nerve endings was also changed substantially by the radiation injury. The first new nerve fibers appeared in the region of the wound only after 15 days in the case of the first and second series. They appeared after one week in the third series. As a rule the total number of nerve fibers regenerated (particularly in animals of the first and second series) was somewhat less than the number of axons that had disintegrated. The observations showed that the peculiarities of the course and the rate and character of the wound process in irradiated animals were not limited only to general tissue changes. They extended also to the peripheral divisions of the nervous system. Moreover, one could suppose that these changes substantially determined both the peculiarities of the course of the wound process against the background of irradiation and also its outcome. It was stressed that regeneration of the peripheral nervous system was reduced, distorted, and primitive. (JPRS)

33877 RADIATION-INDUCED ABNORMALITIES IN THE CHICK EMBRYOS TREATED WITH URETHANE. **Diwan, B. A.; Batra, B. K. (Tata Memorial Center, Bombay). Arch. Entwicklungsmech. Organ., 161: 319-24(Nov. 15, 1968).**

Four groups of chick embryos were treated as follows. The first group of embryos was given a single dose of 0.5% urethane at the definitive primitive streak stage; the second group was irradiated with 300 R x rays at the same stage; the third group was treated with urethane (0.5%) at the definitive primitive streak stage and following six hr incubation was irradiated with 300 R of x rays; the fourth group was irradiated with 300 R x ray at the definitive primitive streak stage and after six hr incubation was treated with 0.5% urethane. The fifth untreated group was used as control. After urethane treatment alone the embryos did not show any abnormalities. X-ray treatment alone also did not cause any malformation in the embryos. After successive administration of two agents, irrespective of which was first, a significant incidence of gross deformation of various organs, including brain, heart, and somites, was observed. (BBB)

33878 COMBINED EFFECT OF TEN FOLD VIBRATION AND FRACTIONATED GAMMA IRRADIATION ON THE STATE OF SPINAL CORD REFLEX ACTIVITY IN GUINEA PIGS. **Kuznetsova, M. A. pp 125-44 of Nekotoryye Voprosy Kosmicheskoy Neyrofiziologii. Moscow, Izdatel'stvo Nauka, 1967. (In Russian).**

The effect of repeated vibratory stress and low-dose irradiation on the functional state of the reflex arc was compared with that of the same irritants applied once or twice. Indicators for the functional state were alertness threshold and the latent period for non-conditioned defensive motor reaction. Sixteen guinea pigs were subjected to five irradiations with 100 R (^{60}Co) at 52 R/min at an interval of three to four days. Thirty to 40 min before and one day after each irradiation, the animals were subjected to 15 min vibration at 70 cps and a 0.4 mm amplitude accompanied by a noise of 75 decibels. Two other groups served as controls. The animals were tested on the day following irradiation, on the last day of treatment and 1, 3, 5, 8, 10, 13, 15, and 18 days thereafter. Blood, weight, and clinical condition of the animals were also monitored. Two of the animals subjected to the full test died after the end of the test, a third death occurred in a group subjected only to irradiation. Physiologic parameters were not significantly changed. In respect to conductivity of the reflex arc, considerable disturbance was seen, mainly in variations of the latency period and depression of reactive force. According to this effect, the animals could be divided into three types. In the first and largest group, the vibratory effect prevailed. The effect of radiation was seen in an increase of the vibratory effect and lasted almost throughout the observation period; controls subjected to vibration only recovered much faster. A mixed reaction occurred in the second group: either factor prevailed in the first or second part of the observation period, and they also alternated throughout that period. The third type of reaction was seen only in one animal; it was practically the same as in the irradiated animals. In comparing the present to earlier work involving single or double vibration and one acute irradiation, the effect of vibration was higher and that of irradiation lower here. It was concluded that the combined effect of 10 vibratory exposures and five irradiations caused decreased reflectory alertness and conductivity and led to parabiotic states in the spinal arc of non-conditioned defensive motor reaction. The varying specific importance of each factor in multiple, single, or double application showed the importance of the time factor in the complex interaction of radiation and dynamic factors. It was suggested that these findings could contribute to an explanation of some mechanisms in radiation sickness. (ATD)

33879 COMPARATIVE STUDIES ON RECOVERY FROM X- OR γ-RAY INJURY IN MICE. **Okamura, Shigeaki; Umayahara, Akira (Kyushu Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 28: 102-12(Apr. 1968). (In Japanese).**

The equal effect ratio of ^{60}Co γ rays was compared with 190 kVp x rays by the use of a two equally fractionated irradiation method. At the irradiation intervals of o (namely single exposure), 1, 3, 6, and 10 days, $LD_{50/30}$ of x rays were 453.0, 522.8, 561.0, 619.1, and 706.5 rads, and $LD_{50/30}$ of γ rays were 661.0, 790.1, 836.9, 931.5, and 1051.5 rads respectively. The equal effect ratio of γ rays was about 0.7 at every interval. By assuming that the relation between $LD_{50/30}$ and the root of intervals is linear, modified $LD_{50/30}$ were calculated. By the use of these modified $LD_{50/30}$ residual latent injury, recovery, recovery percent/day, recovery factors, and half-recovery time for x-ray and γ-ray injury were calculated and compared with each other. There was no significant difference between x-ray and γ-ray injury. (NSA of Japan)

33880 DIURNAL RHYTHMICITY IN THE SENSITIVITY OF HAEMOPOIETIC CELLS TO WHOLE-BODY IRRADIATION OF MICE. **Ueno, Y. (Kyoto Univ.). Int. J. Radiat. Biol., 14: 307-12(1968).**

When mice were maintained on a light–dark cycle in which the light began at 06.00 and ended at 18.00 hours, endogenous spleen colony-forming cells were most radiosensitive at 02.00 and most radioresistant at 22.00 hours. There were three cycles of radiosensitivity with a cycle time of eight hr. The results were discussed on the basis of the cellular kinetics of the haemopoietic cell system. (auth)

33881 EFFECTS OF ULTRAVIOLET RADIATION ON THE ELECTRICAL AND PERMEATIVE PROPERTIES OF THE TOAD URINARY BLADDER. **Redenbo, James Martin. Urbana, Ill., Univ. of Illinois, 1968. 133p.**

Thesis.

The direct current and transient electrical properties of the urinary bladder of the toad Bufo Marinus and the effect of uv radiation on the electrical and permeative properties of this tissue were studied. The complete characterization of the direct current and transient electrical properties was summarized in an electrical analog consisting of a constant voltage source, three fixed resistances, and a capacitance. This analog, along with the experimental transient responses of the tissue to a sudden short circuit, allows one to obtain information about the trans-tissue resistance and capacitance in less than one second. This information was used to determine the change in membrane resistance during and after irradiation. (Disser. Abstr.) (TSS)

33882 MOLECULAR MECHANISMS OF LIVER REGENERATION. VII. CONVERSION OF CYTIDINE TO DEOXYCYTIDINE IN RAT REGENERATING LIVERS. **King, Conrad D.; Van Lancker, J. L. (Univ. of Wisconsin, Madison. Brown Univ., Providence). Arch. Biochem. Biophys., 129: 603-8(Feb. 1969).**

Ribonucleotide reductase activity was measured in a high speed supernatant fraction of regenerating rat liver. The activity of the enzyme varied with the concentrations of ATP in the reaction mixture at pH 8.0. While no enzyme activity could be demonstrated in normal liver, the activity of the reductase was well developed at 24 hr after hepatectomy, and further increased between 24 and 36 hr after operation. Inasmuch as whole-body x irradiation and the injection of actinomycin D interfered with the development of reductase activity in regenerating liver, it is proposed that ribonucleotide reductase is formed de novo in regenerating rat liver. (auth)

33883 INFLUENCE OF ^{60}Co GAMMA IRRADIATION ON THE ACTION POTENTIAL OF THE FROG SCIATIC NERVE. Leicher, Z.; Jamakosmanovic, A.; Nakas, M. (Univ., Sarajevo, Yugoslavia). Folia Med. Fac. Med. Univ. Saraeviensis, 11: 155-63 (1967). (In Slovak).

Isolated preparations of the sciatic nerve of the frog were irradiated with ^{60}Co γ in doses of 20 and 50 kR. In the first 4 to 10 hr after the irradiation the nerves displayed a depression of the amplitude of the action potential by 30% in relation to the controls. However, between the 30th and 48th hr the irradiated nerve showed a greater electrophysiological activity than the control preparations. Immediately after irradiation the nerves treated with a dose of 50 kR displayed a lengthening of the latent period, which suggested diminution of the speed of conduction of the nervous impulse. In the same series, irradiated with 50 kR, after 30 hr there occurred a relative lowering of the tension of the irritation threshold in relation to the controls and nerves irradiated with 20 kR which indicated that the sensitivity of nerves irradiated with 50 kR had increased. (auth) (TSS)

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Refer also to abstracts 33639, 33720, 33748, and 33806.

33884 (N-68-32707) AEROSPACE MEDICINE AND BIOLOGY. A Continuing Bibliography with Indexes. (National Aeronautics and Space Administration, Washington, D. C.). July 1968. 150p. (NASA-SP-7011(52)). CFSTI.

References are presented to literature on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety, survival, life support systems, exobiology, and personnel factors receive appropriate attention. Each entry consists of a standard citation accompanied by its abstract. (auth) (STAR)

33885 LOCAL RADIATION DAMAGE TO BONE AND MARROW DEMONSTRATED BY RADIOISOTOPIC IMAGING. Bell, Edward G.; McAfee, John G.; Constable, William C. (Upstate Medical Center, Syracuse, N. Y.). Radiology, 92: 1083-8(Apr. 1969).

In 10 patients with testicular tumors, pelvic irradiation to tissue doses of approximately 3,000 Rads in three weeks resulted in localized depression in the skeletal uptake of ^{18}F and marrow uptake of ^{99m}Tc sulfur colloid, as determined by external imaging. This change was not accompanied by radiographic evidence of radiation injury. Although this depression varied considerably in degree from one patient to another, it persisted for many years following irradiation. The depression in the reticuloendothelial activity tended to be more pronounced than the reduction in the avidity of bone for ^{18}F. These phenomena can probably be explained by localized reduction in skeletal and marrow blood flow due to radiation degeneration of the microvasculature. Awareness of these findings is important for the correct interpretation of skeletal or marrow radioisotopic images in patients who have received asymmetrical fields of irradiation in the past. A localized decrease in reticuloendothelial activity could be wrongly interpreted as a sign of infiltration of the marrow, with foreign or abnormal tissue, and asymmetrical skeletal activity could be misconstrued as pathological involvement of the normal side. (auth)

33886 LASER DAMAGE THRESHOLDS FOR OCULAR TISSUES. Peppers, Norman A.; Hammond, Ann H. (Stanford Research Inst., Menlo Park, Calif.). Amer. Ind. Hyg. Ass. J., 30: 218-25(May-June 1969).

Safe laser exposure levels have enormous commercial and military ramifications and must be set neither too high nor too low. Linear thermal models indicate ranges over which thresholds increase with increasing exposure time and decreasing spot size. Reported thresholds depend on the damage criterion used. There are significant experimental uncertainties in determining energy distribution on the retina at both small and large spot sizes. Human threshold values extrapolated from animal data may be questionable, but human data are being gathered. Graphs comparing theoretical models, experimental threshold values, and recommended safe levels are shown; references to original data are given. (auth)

33887 A FLUORESCEIN ANGIOGRAPHIC STUDY OF MACULAR DYSFUNCTION SECONDARY TO RETINAL VASCULAR DISEASE. VI. X-RAY IRRADIATION, CAROTID ARTERY OCCLUSION, COLLAGEN VASCULAR DISEASE, AND VITRITIS. Gass, J. Donald M. (Univ. of Miami, Fla.). Arch. Ophthalmol. (Chicago), 80: 606-17(Nov. 1968).

Fluorescein angiography is used to demonstrate alterations in the retinal capillary bed in patients with loss of central vision secondary to x-ray irradiation of the orbital areas, unilateral internal carotid artery occlusion, scleroderma, and chronic inflammation of the vitreous. (auth)

33888 SKIN REACTIONS TO HIGH ENERGY ELECTRONS. Eschwege, F.; Dutreix, J. (Institut Gustave-Roussy, Villejuif, France). Ann. Radiol., 12: R67-74(1969). (In French).

The study of cutaneous reactions is complicated by variability from one individual to another and by their difficulty of assessment and description. As far as electrons are concerned a particular dosimetric problem is encountered; that is the determination of the initial part of the depth dose curve which shows marked variations from one generator to another. In practical terms, for a fractionated treatment delivering about 1,000 Rads per week, the following reactions will be observed: slight skin reaction at 2,500 Rads skin dose; moderately intense skin reaction at 3,450 Rads skin dose; and intense skin reaction between 3,450 and 4,600 Rads skin dose. The early skin reactions do not seem qualitatively different from those seen with orthovoltage x-rays. The doses are also comparable if an RBE (relative biological efficiency) of 0.85 is taken for electrons. In the limited number of patients, and for the reactions observed the following factors have not been found to exert an important effect: energy (between 10 and 20 MeV); field area (between 25 and 300 cm^2). (auth)

33889 RESULTS OF TOTAL-BODY RADIATION OF SIX CHILDREN WITH EWING'S SARCOMA. Shapiro, Fred. Proc. Inst. Med. Chicago, 27: 52-3(May 1968).

The effects of whole-body irradiation, as a new treatment for Ewing's sarcoma, and the management of complications are reported. The program called for a dose of 6000 R in 4 weeks for the primary tumor, irradiation of any known secondaries with ~2000 R, and total-body irradiation of 300 rad. All therapy was given using a ^{60}Co teletherapy unit. The postirradiation medical management of the patient was formidable and a multi-disciplined endeavor. The response of the patients to total-body irradiation was remarkably similar. After about 1 hr in the irradiation period, nausea and vomiting invariably occurred. The hemoglobin dropped slowly and gradually reached its nadir 30 days postirradiation. The serum Fe rose within 1 week of irradiation and did not fall until the fifth week when increased reticulocyte counts heralded recovery of hematopoiesis. The white blood counts dropped within a week of irradiation and remained at the 1500 to 2500/mm^3 range until the third week, when a further drop occurred which reached its nadir of between 400 and 600 cells in the interval between the 25th and 30th postirradiation day. During this period of maximum depression of white blood cells 4 patients developed signs of infection with fever and chills. Signs of infection were treated with broad spectrum antibiotics and blood transfusions if indicated. (BBB)

33890 CHANGES IN THE HEART AFTER RADIATION THERAPY. Nagai, Shunzo; Matsuo, Toshifumi (Osaka National Hospital). Iryo, 21: 1016-21(Sept. 1967). (In Japanese).

Previous reports of enlargement of the heart observed after radiation therapy of tumors in areas adjacent to the heart, such as esophageal, bronchial, or breast cancer, are reviewed. Changes in the heart caused by therapeutic irradiation were studied radiologically in patients that received thoracic doses of 6000 to 8000 rad from ^{60}Co. Heart enlargement was found to be more frequent after doses of irradiation given over large areas of the heart, less frequent after small-area irradiation. Planimetric measurements were made of the size of the heart after postoperative irradiation for right or left breast cancer. Cardiac hypertrophy was usually detected between 1.5 and 7 months after irradiation; however, a return of heart volume toward preirradiation levels was observed later (at ~12 months). It is suggested that this cardiomegalic effect is associated with pericardial effusion as a result of radiation serositis. (BBB)

33891 LATE SEQUELAE IN THE REGION OF THE URINARY SYSTEM AFTER GYNECOLOGIC RADIOTHERAPY. Helbing, W. (Univ., Halle/Saale, Ger.). Zentralbl. Chir., 92: Suppl., 2022-6 (1967). (In German).

Factors that influence development of urological irradiation injuries after Ra treatment of gynecologic tumors were discussed and reviewed. It has been found that frequent emptying diminished exposure of the bladder. Fractionation of the Ra dose into three implants made over a period of 14 days with single exposure limited to less than 24 hr also helped to protect the bladder from irradiation. Ureteral strictures were prevented if pendulum x irradiation was limited to 3000 R or less. When ultrahard betatron or γ irradiation was used, postirradiation ureteral stenoses were decreased from 26 to 6% incidence. In 156 patients studied, 26%

had irradiation complications that consisted of silent kidneys, hydronephrosis, and pyelonephritis. The frequency of ureteral stenoses was decreased when the dose to the ureters was kept less than 4000 R. However, various inflammatory processes, such as paraureteritis, periureteritis, and ureteritis may affect pre-existing functional disturbances. (BBB)

33892 INTERDEPENDENCE AMONG SOME FACTORS OF IMPORTANCE IN THE DEVELOPMENT OF RADIATION CHANGES IN CHILDREN. Lokajicek, M.; Stasek, V.; Palecek, L.; Kolar, J. (Charles Univ., Prague). Neoplasma, 16: 111-14(1969).

The development of radiation changes in children following x radiation with large doses was followed in the spine. The interdependence among the absorbed dose (D), age at the time of irradiation (T), and the interval (I) between the time of irradiation and the appearance of the changes concerned were noted. A relation was found between the degree of radiation change and the interval (I). Structural changes, slight to gross deformity, corresponded to intervals averaging $2\frac{1}{2}$ yr, $5\frac{1}{2}$ yr, and $7\frac{1}{4}$ yr, respectively. For an interval of 1 yr no radiation changes were found in the spine. It was concluded that under given conditions an equivalent biological effect can be induced in the early stages of an organism's development by a very small dose. (C.O.)

33893 ADULT BRONCHOPULMONARY DYSPLASIA: THE SIMILARITY IN ROENTGEN AND HISTOPATHOLOGIC APPEARANCE BETWEEN SOME CASES OF OXYGEN TOXICITY, RADIATION PNEUMONITIS, AND POSTCYTOTOXIC NONSPECIFIC BRONCHOPNEUMONIA. Meschan, I.; DeArmas, C. R.; Schary, M. (Wake Forest Univ., Winston-Salem, N. C.). Radiology, 92: 612-15(Mar. 1969).

The similarities in gross and microscopic histological findings and radiographs of the lungs of patients with bronchopulmonary dysplasia attributed to radiation pneumonitis, busulfan therapy, or oxygen therapy are discussed. It is postulated that free radical production by the toxic agents employed, and the effect of these free radicals on lung surfactant may be involved in the etiology of bronchopulmonary dysplasia. Similarities in the pathological findings and those in the lungs of infants with respiratory distress treated with prolonged artificial ventilation are discussed. (C.H.)

33894 DISEASES AGGRAVATED BY SUNLIGHT. Cripps, Derek J. (Univ. of Wisconsin, Madison). Postgrad. Med., 41: 557-67(May 1967).

Biological effects of uv radiation are reviewed and the numerous diseases that may be caused or aggravated by uv and other radiations in sunlight are considered. Methods of reproducing solar uv effects in the skin by the use of mercury vapor lamps are described. To determine the action spectrum of the photodermatosis, the skin of the subject should be irradiated with narrow wavelength bands of light of known energy. Intensity measurements can be made with a thermopile; for example, the mean value of the intensity of light at 300 mμ that could cause a minimum erythema dose (MED) was determined to be 2.5×10^4 $\mu W/cm^2$. Examination of a patient with symptoms of photosensitivity may suggest one of the following diseases: porphyria, lupus erythematosus, Bloom's syndrome, Cockayne's syndrome, xeroderma pigmentosum, lipid proteinosis, pellagra, pellagrous dermatitis of carcinoid, Hartnup's syndrome, albinism, phenylketonuria, vitiligo, polymorphic light eruption, hydroa aestivale, drug photosensitivity, or photocontact dermatitis. (BBB)

33895 ABNORMALITIES IN CHILDREN EXPOSED TO X-RADIATION DURING VARIOUS STAGES OF GESTATION: TENTATIVE TIMETABLE OF RADIATION INJURY TO THE HUMAN FETUS. PART I. Dekaban, Anatole S. (National Inst. of Health, Bethesda, Md.). J. Nucl. Med., 9: 471-7(Sept. 1968).

Severe and obvious abnormalities encountered in 26 children who received heavy doses of x radiation during various stages of gestation were compiled and evaluated. The following conditions occurred most frequently: stunted growth, microcephaly, mental retardation, microphthalmus, pigmentary degeneration of the retina, cataracts, and genital and skeletal anomalies. A tentative timetable for man is presented which correlates specific types of abnormalities with irradiation during particular stages of gestation when the dose is in the range of therapeutic irradiation. On the basis of the patient material presently available and with some support of experimental data the following generalizations are made: moderately large dose of ionizing radiation (over 250 R but the upper limit cannot be stated) delivered to the human embryo before 2 to 3 weeks of gestation is not very likely to produce severe abnormality in most of the children born although experimental data indicate that considerable numbers of these embryos are resorbed or aborted; irradiation of the fetus with doses used in medical therapeutics between 4 and 11 weeks of gestation would lead to severe abnormalities (predominantly malformation) of many organs in most or all of the children; irradiation in a similar dose range between 11 and 16 weeks of gestation may produce little or no eye (late cataracts not considered), skeletal and genital organ abnormalities but stunted growth, microcephaly and mental retardation is frequently present; irradiation of the fetus between 16 and 20 weeks of gestation with a similar dose range may lead only to mild degrees of microcephaly, mental retardation and stunting of growth; and irradiation of the fetus with a similar dose range after 20 weeks of gestation is not likely to produce overt abnormalities leading to a serious handicap in early life, however, a proportion of the infants may show evidence of irradiation exposure such as skin erythema, abnormal pigmentation, epilation, or deficiencies in the hematopoietic system. (auth)

33896 UNUSUAL FIBROSIS OF THE LUNG CAUSED BY GRID IRRADIATION IN BOECK'S SARCOID. Simay, A. (Medical Univ., Debrecen, Hungary); Szabo, A. Beitr. Klin. Erforsch. Tuberk., 135: 111-5(1967). (In German).

A report is presented of a case of an unusual fibrosis of the right lung after therapeutic x irradiation of a lung neoplasm using a grid. It is possible that the tissues of the patient had a disposition to form keloid. The additional effect of 2×1000 R grid irradiation supposedly resulted in the appearance of linear shadows in the lung, radiating from the right axillary region. (auth)

33897 ACUTE MONOCYTIC LEUKEMIA 13 YEARS AFTER A CAROTID ARTERIOGRAPHY WITH THOROTRAST. Pijpers, P. M. (St. Elisabeth- en Maria-Ziekenhuis, Tilburg, Netherlands). Ned. Tijdschr. Geneesk., 112: 799-803(Apr. 27, 1968). (In Dutch).

A case of acute monocytic leukemia in a woman aged 65 yr is reported. An autopsy microscopic examination revealed the presence of deposits of x-ray contrast medium in the liver, spleen, and bone marrow. Autoradiographic examination showed that this material was Thorotrast. A causal relation between the injection of Thorotrast and the development of acute monocytic leukemia 13 yr later is regarded as highly probable. (BBB)

33898 LATE DAMAGES AFTER INTERNAL APPLICATION OF THORIUM X (^{224}Ra). Schales, F. (Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main). Atompraxis, 14: 470-3(Nov.-Dec. 1968). (In German).

Besides the known groups of persons with damages by internally deposited radionuclides (e.g., radium workers and thorotrast patients), another group of persons shows markedly increased incidence of bone sarcoma and blood diseases: From 1946 to 1951 about 2000 patients, among them many children, were treated in a German sanatorium for extrapulmonary tuberculosis and some other diseases by injections of thorium X (^{224}Ra, half-life 3.64 days). While the tuberculosis therapy was stopped in 1951, the therapy of ankylosing spondylitis with low amounts of ThX is being continued in several German university hospitals, where another 1000 patients were treated. By physical measurements of patients from this last group the author studied the metabolism of ThX in man and calculated radiation doses. The possible admixture of long-living radionuclides to the medical ThX preparations was checked. In the meantime more than 50 cases of sarcoma and more than 10 cases of blood diseases within the first group of patients were reported. The pertinent radiation doses in skeleton and blood-forming organs are given and related to doses after radium-226 and thorotrast depositions. (auth)

33899 THE CHANGE OF NUCLEAR-CYTOPLASMIC DIAMETER RATIO OF DESQUAMATED VAGINAL SQUAMOUS EPITHELIAL CELLS DURING RADIOTHERAPY OF CERVICAL CANCER OF THE UTERUS. Umemiya, Shigenobu (Fukushima Prefecture Medical Coll., Japan). Nippon Sanka Fujinka Gakkai Zasshi, 20: 1105-14(Sept. 1968). (In Japanese).

In 25 patients who underwent radiotherapy for stage II or more advanced stages of cervical cancer of the uterus, 50 smear preparations were made and 4770 desquamated vaginal squamous epithelial cells were examined. Based on malignancy, cells were classified morphologically into four types and further subdivided into four grades. Changes in desquamated cells following irradiation were studied by adopting cell swelling as an indicator; nuclearcytoplasmic diameter ratios were calculated. Most of the deep-seated cells were malignant and most of the superficially-seated cells were benign. Non-malignant cells became predominant as the radiation dose increased; however, at high doses, some malignant cells remained. Generally, cell swelling following irradiation augmented until a 15,000 R dose was reached; this was especially striking in malignant cells. Above a 15,000 R dose, the degree of cell swelling tended to decrease. The cytoplasmic diameter was nearly constant in each cell type and was larger in cells seated more superficially. The nuclear diameter

was nearly constant in each cell grade of malignant and benign cells and was larger than 12 μ in malignant cells. The nuclear diameter of benign cells, with the exception of irradiated cells, was below 12 μ. It was concluded that nuclear-cytoplasmic diameter ratio seemed to be convenient for expressing cell character. (TSS) (NSA of Japan)

33900 EFFECT OF ELECTROMAGNETIC RADIATION OF THE ORDER OF CENTIMETER AND METER WAVES ON HUMAN'S HEALTH. Pazderova, Jana. Prac. Lek., 20: 447-57 (Dec. 1968). (In Czech).

The biological hazard contributed by microwave irradiation is evaluated and the pathological effects of microwave irradiation on personnel working within close range of electrostatic fields are discussed. Tissue destruction, morphological effects on the central nervous system, and general effects of intensive microwave irradiation on living organisms during chronic exposure are reviewed. A critical evaluation is given of maximum permissible levels of microwave radiation exposure. (R.V.J.)

33901 LIFE SCIENCES RESEARCH AND LUNAR MEDICINE. Proceedings of the Second Lunar International Laboratory (LIL) Symposium, Madrid, 13 October 1966. Malina, Frank J. (ed.). New York, Pergamon Press, 1967. 126p. $10.00. (CONF-661068).

Ten papers are presented on research preparatory to manned exploration of the lunar surface. A paper on the potential radiation hazards to human habitation was abstracted separately for NSA. The 9 remaining papers discuss: physiological aspects of the transition from space vehicle to lunar environment; psychosociological problems in small isolated groups working under extreme conditions; construction of a lunar microcosm; life-support systems; liquid motion at zero gravity; human locomotion and visual performance on the moon; and medical tasks connected with the lunar mission. A paper on organic analysis of subsurface lunar material is summarized. (H.G.D.)

For an abstract of the individual paper see: 33903.

33902 EPIDEMIOLOGY OF LEUKEMIA. Neumann, G. (Staedtisches Gesundheitsamt, Stuttgart, Ger.). Internist, 9: 470-6(Dec. 1968). (In German).

The problem of leukemia induction by exposure to ionizing radiation is discussed. Leukemia incidence was reported to be 2.5 times as frequent in physicians exposed to irradiation as compared to nonexposed physicians. The incidence of leukemia was 0.4%, or 9.5 times the expected value in patients treated for ankylosing spondylitis by radiotherapy. After x irradiation of the thymus in children the probability of leukemia was increased three-fold, and thyroid carcinoma also was reported to follow these types of irradiation. Leukemia incidence was increased after x irradiation epilation of the scalp. In Japan the acute forms of leukemia have predominated over the chronic lymphatic forms since the nuclear explosions in Hiroshima and Nagasaki, and the incidence may have peaked. Reports have estimated that diagnostic x irradiation is responsible for a one to eight percent contribution to leukemia incidence. Neither cosmic nor terrestrial background irradiation have had any perceptible effects on leukemia incidence. (BBB)

33903 RADIATION HAZARDS TO MAN ON THE MOON. Schaefer, H. J. (Naval Aerospace Medical Inst., Pensacola, Fla.). pp 83-95 of Life Sciences Research and Lunar Medicine. Malina, Frank J. (ed.). New York, Pergamon Press, 1967.

From 2nd Life Science Research and Lunar Medicine Symposium, Madrid, Spain. See CONF-661068.

Three components make up the radiation environment on the Moon: β and γ radiation from radioactive trace minerals in lunar rock, ordinary cosmic radiation, now preferably called galactic radiation; and solar particle beams. For the first component, significant differences from terrestrial conditions are not likely to exist. Basically different are conditions for the second and third component because of the lack of an atmosphere and a magnetic field on the Moon. Since man on the Moon will always need a pressurized enclosure, radiation spectra are of interest only above a certain minimum penetrating power corresponding to the shielding equivalent of the enclosure. While this inherent shielding power would greatly reduce the dose from solar particle beams, it does exactly the opposite for galactic radiation because of the so-called build-up phenomenon, i.e., the multiple production of secondaries. For galactic radiation, the lack of an atmosphere means that the build-up will occur, on the Moon, in the local compact matter of a space suit, a vehicle, or the structural material of a permanent building, as the case may be. Within limits, inferences can be made as to the influence of such interposed material on the tissue dose in man. A serious gap in present knowledge exists with regard to the low-energy section of the galactic spectrum at solar minimum. Since at solar minimum the interplanetary magnetic field is weak or non-existent, its modulating effect on the galactic beam is greatly reduced, and low-energy particles are admitted that might substantially increase exposure. This is one area where better data on the physics of galactic radiation are needed. Radiobiologically, a controversial issue in assessments of radiation damage from galactic radiation are the microbeam effects of heavy nuclei. Though they are not likely to lead to acute incapacitating injury, heavy particles are known to be especially effective in producing delayed long-term damage. This problem, then, will assume importance for long-term exposures in lunar colonization. Exposure conditions for solar particle beams will not differ basically from those in free space except for the shielding effect of the lunar body. The estimates made by many investigators for free space conditions, therefore, hold essentially also for the lunar surface. Substantial flare protection could be accomplished by utilizing features of the lunar terrain such as narrow valleys or caves. At a state of a more advanced lunar technology, flare radiation shelters could be dug out. Little is known on the radiation levels that will persist for some time after large flares due to isotopes produced by the neutron component of the flare beam. (auth)

Radiation Effects on Plants

Refer also to abstracts 33666, 33672–33674, 33676, 33680, 33683, 33684, and 33687.

33904 (CEX-68.4) RADIOSENSITIVITY OF CERTAIN PERENNIAL SHRUB SPECIES BASED ON A STUDY OF THE NUCLEAR EXCAVATION EXPERIMENT, PALANQUIN, WITH OTHER OBSERVATIONS OF EFFECTS ON THE VEGETATION. Rhoads, W. A.; Platt, Robert B.; Harvey, Robert A. (EG and G, Inc., Santa Barbara, Calif.). Oct. 1967. 42p. Dep. CFSTI.

Sensitivities of certain species of plants from the higher elevations of the Nevada Test Site to gamma radiation from a ^{60}Co source and from conditions in the fallout pattern of the nuclear excavation experiment Palanquin were compared. Artemisia, sage brush, appeared much more sensitive to fallout, based on the infinite dose received, than was predicted by the pure gamma dose from ^{60}Co. The proposal was made that beta radiation contributed a greater dose to Artemisia than to certain other species because of its particular capacity for foliar retention of fallout particles. This suggested that beta radiation may be an important factor in considering fallout damage to vegetation, since other factors known to have damaged vegetation in nuclear experiments could, for the most part, be eliminated. (auth)

33905 POSTIRRADIATION MODIFICATION OF ULTRAVIOLET-SENSITIVITY OF NORMAL AND NITROFURAZONE-RESISTANT STRAINS OF THE BLUE-GREEN ALGA ANACYSTIS NIDULANS. Singh, H. N.; Kumar, H. D.; Prakash, Gyan (Univ. of Udaipur, India). Radiat. Bot., 9: 105-10(Mar. 1969).

An apparently stable nitrofurazone-resistant strain of the blue green alga Anacystis nidulans was isolated subculture of the organism in nitrofurazone-supplemented medium followed by selection in a higher concentration of nitrofurazone. The strain so obtained was found to be more resistant to uv radiation than the parent strain. Postirradiation treatment of resistant and normal strains with acriflavine enhanced the efficiency of uv-killing, whereas similar treatment with distilled water diminished it; postirradiation treatment with yeast extract at first increased but later decreased the efficiency of uv-killing. (auth) (UK)

33906 HISTOLOGICAL CHANGES INDUCED IN SHOOT APICAL MERISTEMS OF CANARY GRASS AFTER IRRADIATION. Prasad, A. B. (Univ. of Bihar, Muzaffarpur, India). Nucleus (Calcutta), 11: 75-8(June 1968).

Dry dormant seeds of Phalaris canariensis were irradiated with 10 kR and 20 kR x rays and were allowed to germinate on moist filter paper in petri dishes at 15°C. Histological examination showed that the inner region was apparently more sensitive than the outer at both the doses. A regeneration of new meristem both at 10 kR and 20 kR was seen though regeneration started a little earlier at 10 kR. The causes of regeneration of new meristem and bifurcation of meristem are discussed, and it was concluded that the persistence of cells carrying structural abnormalities might be responsible for such regeneration. (auth)

33907 CYTOLOGY OF IRRADIATED MOUGEOTIA SP. Prasad, Braj Nandan; Godward, M. B. E. (Univ. of Lucknow, India. London Univ.). Nucleus (Calcutta), 11: 43-9(June 1968).

Vegetative filaments of a Mougeotia sp. were exposed to β rays produced from a Van de Graaff apparatus at doses from 2,200 R to 64,500 R and the effects on mitosis and growth were observed. The

lower doses (2,200 R and 2,800 R) caused no visible cytological aberration although mitosis was delayed by 4 to 5 days. At doses of 5,600 R and higher, fragments of chromosomes were produced and these occasionally were left behind at anaphase and not incorporated in the daughter nuclei; micronuclei were, however, not formed. At higher doses of radiation, densely straining regions resulting in stickiness of the chromosomes were evident and increased with the increase in dose of radiation. The chromosome fragments were carried to the poles at anaphase by their sticky attachment, and this prevented loss of genetic material. At 26,200 R, stickiness was so pronounced that anaphasic separation was incomplete and unseparated daughter nuclei appeared like a single abnormal nucleus with two nucleoli. A dose of 38,800 R prevented the nucleus from undergoing further division, but the cytoplasm survived and cells elongated abnormally and ultimately died. (auth)

33908 THE EFFECT OF HYPOXIA ON RECOVERY OF SUBLETHAL RADIATION DAMAGE IN VICIA SEEDLINGS. **Hall, Eric J.; Cavanagh, Josephine (Churchill Hospital, Oxford). Brit. J. Radiol., 42: 270-7(Apr. 1969).**

Seedlings of Vicia faba were used as a test system to investigate the recovery from sub-lethal radiation damage. Groups of seedlings were exposed to single and fractionated doses under four treatment regimes; air present during the irradiations and during the interval between dose fractions; air present during the irradiations but hypoxic conditions between the doses; hypoxia during the doses but air available between doses; hypoxia maintained both during and between the irradiations. It was found that some degree of recovery of sublethal damage took place under all conditions, but the amount of recovery was substantially reduced if a state of hypoxia was maintained between the dose fractions. The state of oxygenation during the x-ray exposure was relatively unimportant. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 33629, 33632, 33641, 33677–33679, 33685, 33686, and 33832.

33909 (TID-24779) GROWTH CHARACTERISTICS OF TYPE E CLOSTRIDIUM BOTULINUM IN THE TEMPERATURE RANGE OF 34° TO 50°F. Annual Report, June 29, 1964–January 14, 1966. (Continental Can Co., Inc., Chicago, Ill. Metal Div. Research and Development). Jan. 14, 1966. Contract AT(11-1)-1183. 116p. Dep. CFSTI.

Preparation and standardization of spore suspensions and thermal inactivation of Type E toxin are described. Possible synergistic effects of sodium benzoate, sodium p-hydroxybenzoate, sodium nitrite, and Na_2EDTA with low doses of irradiation were investigated. Fish homogenate samples containing the additives were inoculated with Beluga Type E spores. In the presence of 50 to 150 ppm sodium nitrite and with a 0.322 M rad dose, spores exhibited a gradual increasing extension of outgrowth time. Sodium p-hydroxybenzoate appeared to be somewhat more inhibitory than sodium benzoate. With a 0.644 Mrad dose, a considerable reduction in the inhibitory level of nitrate was observed. Only a moderate extension of spore outgrowth time occurred when Na_2 EDTA was combined with a 0.322 Mrad dose. Type E spores in haddock homogenate and phosphate buffer were γ-irradiated and incubated at various temperatures. With incubation at 46°F, more than a twofold reduction in radioresistance was observed as compared with incubation at 85°F. (H.L.W.)

33910 BIOLOGICAL AND PHYSICAL PROPERTIES OF A LEUKEMOGENIC AGENT OF A NEW TYPE OF VIRAL MURINE LEUKEMIA. **Libansky, J.; Mach, O.; Novotna, O. (Inst. of Hematology and Blood Transfusion, Prague). Bibl. Haematol., No. 30, 78-80(1968).**

From 3rd International Symposium on Comparative Leukemia Research, Paris, France. See CONF-670732.

A leukemic virus was isolated after x irradiation of leukemic mice and successfully transferred by cell-free material to other strains of mice and to rats. The virus showed similarity to other murine leukemia viruses. Biological and physical properties are briefly described and discussed. The influence of x rays on the leukemogenic activity was tested by irradiating leukemic extract with a ^{60}Co bomb. It was considerably resistant; only doses of 500 kR and 750 kR inhibited but did not suppress the leukemogenic activity of the virus. (C.O.)

33911 PROPERTIES OF A CELL FRACTION THAT REPAIRS DAMAGE TO THE CELL DIVISION MECHANISM OF ESCHERICHIA COLI. **Fisher, William D.; Adler, Howard I.; Shull, Fred W. Jr.; Cohen, Amikam (Oak Ridge National Lab., Tenn.). J. Bacteriol., 97: 500-5(Feb. 1969).**

A factor in bacterial cell extracts that induces cell division in filaments of Escherichia coli produced by irradiation was found to be associated with a heat-labile particulate fraction that sediments at about 100S. Frozen or lyophilized samples of the cell extracts were stable for considerable periods of time. Fractions purified by centrifugation contained 2% of the total protein of the extract but no measurable RNA or DNA. The extracts were inactivated by incubation with phospholipase A, lipases, and detergents, but not by incubation was selected nucleases and proteases. (auth)

33912 INITIATION OF GERMINATION AND INACTIVATION OF BACILLUS PUMILUS SPORES BY HYDROSTATIC PRESSURE. **Clouston, J. G.; Wills, Pamela A. (Australian Atomic Energy Commission, Lucas Heights). J. Bacteriol., 97: 684-90(Feb. 1969).**

The effect of hydrostatic pressures as high as 1,700 atm at 25°C on the heat and radiation resistance of Bacillus pumilus spores was studied. Phosphate-buffered spores were more sensitive to compression than spores suspended in distilled water. Measurements of the turbidity of suspensions, the viability, refractility, stainability, dry weight, and respiratory activity of spores, and calcium and dipicolinic acid release were made for different pressures and times. Initiation of germination occurred at pressures exceeding 500 atm and was the prerequisite for inactivation by compression. The rate of initiation increased with increasing pressure at constant temperature. This result is interpreted as a net decrease in the volume of the system during initiation as a result of increased solvation of the spore components. (auth)

33913 ABSENCE OF REPRESSOR IN SV_{40}-TRANSFORMED CELLS. **Jensen, F. C.; Koprowski, H. (Wistar Inst. of Anatomy and Biology, Philadelphia). Virology, 37: 687-90(Apr. 1969).**

Experiments were conducted to determine whether a repressor-like substance was present in mammalian cells transformed by SV_{40}. SV_{40}-transformed nonpermissive mouse or hamster cells were fused or cocultivated with SV_{40}-transformed African-Green Monkey kidney or human cells. Some of the latter cells had been transformed with ^{60}Co γ-irradiated Adeno 7-SV_{40}. Infectious SV_{40} was isolated which was considered evidence that a repressor substance was not present in transformed mammalian cells. (M.M.B.)

33914 EFFECTS OF PHOTODYNAMIC ACTION ON E. COLI. **Bellin, J. S.; Lutwick, L.; Jonas, B. (Polytechnic Inst. of Brooklyn). Arch. Biochem. Biophys., 132: 157-64(June 1969).**

Photodynamic effects on Escherichia coli were evaluated using neutral red, a sensitizer whose pK is close to the pH of the cell's cytoplasm. By using monochromatic radiation maximally absorbed by either the acidic or alkaline form of the sensitizer, it was ascertained that both lethal and mutational effects are mediated mainly by sensitizer molecules that have penetrated into the cell's interior, and principally by its cationic (acid) form. The mutational (reversion to tyrosine independence) and lethal effects of methylene blue were comparable to those mediated by cationic neutral red. Rose bengal, although showing bactericidal photodynamic action, was unable to elicit mutations. (auth)

33915 SINGLE-PLATE SCREENING TEST FOR POTENTIAL RADIOSENSITISERS OF HYPOXIC BACTERIA. **Hewitt, H. B.; Walder, A. S. (Mount Vernon Hospital, Northwood, Eng.). Brit. J. Radiol., 42: 318-19(Apr. 1969).**

A single-plate screening test for potential radiosensitizers of hypoxic bacteria is described. A plate of nutrient agar was inoculated to a predetermined density with Serratia marcescens and a centrifugal gradient of a radiosensitizing drug was allowed to develop. A predetermined dose of uniform x irradiation was delivered in air to a 1-cm band across the center of the plate and then repeated at right angles to the first in nitrogen. The absence of drug toxicity was indicated by the absence of growth inhibition at the points where the unirradiated quadrants of the plate approached the edge of the site of the drug disc. Sensitization by the drug under hypoxic conditions was shown by the absence of survival in the central part of the band irradiated in nitrogen; the uniformity of survival along the band irradiated in air indicated that the drug had not enhanced the sensitization attributable to oxygen. This test would not recognize substances that exerted action only at toxic levels. (C.O.)

Radiosterilization and Radiopreservation

Refer also to abstract 33687.

33916 BROWNING REACTION IN RADIATION-STERILIZED SEAFOOD PRODUCTS. **Yu, T. C.; Landers, Mary K.; Sinnhuber,**

R. O. (Oregon State Univ., Corvallis). Food Technol., 23: No. 2, 90-2(Feb. 1969).

In developing γ radiosterilized seafood products, one of the problems encountered is non-enzymatic browning of the products during room-temperature storage. The browning reaction was evaluated visually in irradiated and non-irradiated cod patties prepared from leached and unleached fish containing various additives. An accelerated browning reaction test indicated that leached samples, with a lowered reducing sugar content, did not brown as readily as unleached samples. The only irradiated patty to remain white in this test contained antioxidants, binders, SO_2, and $CaCl_2$. Irradiated unleached cod patties stored at 22°C or 38°C for up to 300 days developed a characteristic yellow color while most leached samples similarly stored developed a grey color. The irradiated patties consistently judged lightest in color were leached and, listed in order of lightness, contained antioxidants and SO_2; antioxidants only; or no additives. (auth)

33917 APPLICATION OF IONIZING RADIATION FOR CONTROLLING ACANTHOSCELIDES OBSLETUS SAY (BRUCHIDAE, COLEOPTERA) INFESTATIONS OF LEGUME SEEDS. Cavalloro, Raffaele; Bonfanti, Giorgio (EURATOM, Ispra, Italy). Boll. Zool. Agr. Bachicolt., 8: 115-34(1966-67). (In Italian).

An investigation was made of the application of ionizing radiations for the protection of legume seeds from damage caused by Acanthoscelides obsoletus say (Bruchidae, Coleoptera). This insect, the larvae of which are strictly seed-eating, attacks particularly the genus Phaseolus. Techniques were developed to obtain large numbers of insects of well-defined age for the x-irradiation experiments. The radiosensitivity of the insect was found to vary inversely with its degree of development. Males were more sensitive than females: the sterilization exposure doses are 4000 and 5000 R for males irradiated respectively four days before the end of pupation and on the first day of emergence of the adult, while for the females the corresponding doses are 6000 and 1000 R. Trials made on stored seed infested by insects at all developmental stages showed that an exposure of 5000 R gives adequate protection, the insects still reaching adulthood after this treatment being all sterile. It is concluded that ionizing radiation can be successfully used to control A. obsoletus, either by means of the sterile male technique or by direct irradiation of the stored product. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

33918 (DUN-SA-81) FUTURE VALUE OF PLUTONIUM. Dowis, W. J. (Douglas United Nuclear, Inc., Richland, Wash.). Dec. 13, 1968. 27p. (CONF-690609-2). Dep. CFSTI.

From 15th Annual Meeting of the American Nuclear Society, Seattle, Wash.

A general mathematical expression relating U_3O_8 price, relative plant capital cost, financing costs, and fast reactor Pu doubling time to Pu value was developed. Factors which may affect the future value of Pu and theoretical Pu values are listed. Market price as contrasted to the theoretical value will depend on supply and demand and freedom of world trade. The US is expected to have sufficient Pu for an orderly, fairly rapid buildup of fast breeder capacity but foreign nations will be less well off. After 1990, large and continuing supply beyond economic needs can be prevented by good management. The influence of oversupply on Pu value of the future is more speculative than the trends which are discussed. (F.S.)

33919 (ORNL-4411) SOME FUNDAMENTAL IDEAS IN TOPOLOGY AND THEIR APPLICATION TO PROBLEMS IN METALLURGY. Barrett, Lida K.; Yust, C. S. (Oak Ridge National Lab., Tenn.). June 1969. Contract W-7405-eng-26. 55p. Dep. CFSTI.

The topological ideas and results that have been used by metallurgists, together with several results not previously presented in the metallurgical literature, are developed in a systematic manner. Based on this presentation, a review is given of the use of topology in metallurgy. The additional topology that is introduced is used to establish interrelationships among the results of several papers and to clarify the mathematical treatment. The new ideas introduced include the Alexander Duality Theorem, the Euler–Poincare formula, and the concept of deformation retract. The Euler–Poincare formula is used to relate results of F. N. Rhines to those of J. W Cahn. The topological model of sintering of F. N. Rhines is discussed as a deformation retract. Deformation retract properties, together with the Alexander Duality Theorem, are used to mathematically validate a formula of Kronsbein, Buteau and DeHoff and to establish in a new mathematical manner a formula of Kronsbein and Steele. (auth)

33920 MECHANISM FOR THE SWEEPING-UP OF LOOPS BY GLIDE DISLOCATIONS DURING DEFORMATION. Foreman, A. J. E.; Sharp, J. V. (Atomic Energy Research Establishment, Harwell, Eng.). Phil. Mag., 19: 931-8(May 1969).

Dislocation loops in irradiated or quenched metal crystals are swept out by the glide dislocations during deformation, leaving cleared channels. The removal of prismatic loops with the same Burgers vector as the glide dislocations can occur by direct recombination but the annihilation of loops with Burgers vector out of the glide plane has not been explained. A simple mechanism is proposed for their removal in face-centered cubic crystals. This involves the formation of a junction around half the loop, followed by the gliding together and coalescence of this with the other half. Both steps are glissile and energetically favorable, and give complete annihilation of the loop at the expense of a change in shape of the glide dislocation. Faulted loops may also be removed in this way if they first unfault in the presence of a glide dislocation. The mechanism is not diffusion controlled, but requires a high loop mobility and may be affected by impurity pinning. (auth) (UK)

33921 KORROZIONNYE SVOISTVA ITTRIYA. (Yttrium Corrosion). Al'tovskii, R. M.; Gornyi, D. S.; Eremin, A. A.; Panov, A. S. Moscow, Atomizdat, 1969. 128p.

Physico-chemical properties of yttrium are covered in the first chapter including phase diagrams and preparation of pure yttrium. Corrosion resistance in water and gases, heat resistance and effects of yttrium on heat resistance of metals and alloys are discussed in the following three chapters. The fifth and sixth chapters analyze the compatibility of yttrium with uranium and its alloys and reaction of yttrium with nuclear fuel and construction materials. 160 references. (R.V.J.)

33922 THE METALLURGY OF NUCLEAR FUEL. PROPERTIES AND PRINCIPLES OF THE TECHNOLOGY OF URANIUM, THORIUM, AND PLUTONIUM. Emel'yanov, V. S.; Evstyukhin, A. I. International Series of Monographs in Nuclear Energy. Volume 104. Oxford, Pergamon Press Ltd., 1969. 559p. £12; $32.00.

Translation of Metallurgiya Yadernogo Goryuchego by Anne Foster.

Information is presented in chapters on history of U, physical and mechanical properties of U, effects of various treatments on properties of U, irradiation and thermal cycling effects, chemical properties of U, U alloys, U compounds, ore processing and metal processing. Information on Th is presented in chapters on history of Th, alloys and compounds of Th, processing Th raw materials, and production and working Th metal. Information on Pu is presented in chapters on history of Pu, alloys and compounds of Pu, and methods of separating Pu. (J.R.D.)

33923 POSSIBLE NONDESTRUCTIVE TEST FOR HYDROGEN CONTENT OF METALS. Fernelius, Nils (Argonne National Lab., Ill.). Non-Destruct. Test., 11: 22-3(Mar. 1969).

The intensity of the nuclear magnetic resonance signal of hydrogen can be used as a nondestructive test to determine the amount of hydrogen absorbed on the surface of a metal. Descriptions of the measurement of nuclear magnetic resonance signals and techniques designed to increase the signal-to-noise ratio are discussed. Problems peculiar to ferromagnetic metals are mentioned. (auth) (UK)

Corrosion and Erosion

33924 (GEAP-5602) SODIUM COMPONENTS DEVELOPMENT PROGRAM. MASS TRANSFER INVESTIGATIONS IN LIQUID METAL SYSTEMS. Quarterly Progress Report No. 4, December 1967–February 1968. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). May 1968. Contract AT(04-3)-189. 48p. Dep. CFSTI.

Work is reported on investigations of materials corrosion, mechanical properties, and sodium impurities in pumped sodium systems operating under controlled purity conditions to maximum temperatures of 1300°F. Empirical equations are given representing hot leg corrosion and cold leg deposition observed in 3000 hours. Test conditions were selected for Loop 9, modeling FFTF 5 MW closed loop corrosion conditions. The temperature profile of the hot leg section corresponding to the reactor tube was adjusted to permit operation of the electron bombardment heater at 20 kW (800,000 Btu/h-ft^2 average). The replacement of an anode tube (simulating reactor fuel cladding) on an electron bombardment heater was successfully accomplished. This demonstrated the ability to expose cladding (1 cm diameter × 25.4 cm length in this case) to high heat flux in sodium, remove the cladding for examination, replace or renew the test cladding, and resume test operations. A 10-microsecond solid-state crowbar circuit was developed and tested to divert cathode to anode arcs in the electron beam heaters. The analysis of 6R-1P cladding specimens was continued. Bending stresses associated with pressurized specimens were analyzed for samples which simulate fuel spacers. The flow blockage in a plugging indicator was related to hydrogen additions to a loop. The cold trap was identified as a major source of hydrogen during some operations. (auth)

33925 EFFECT OF GAS FLOW RATE ON THE OXIDATION KINETICS OF ZIRCONIUM. Srivastava, L. P.; Archbold, T. F. (Univ. of Washington, Seattle). Scr. Met., 3: 377-80(June 1969).

The rate of flow of an oxygen-argon mixture over thin zirconium specimens has been found to affect the observed oxidation kinetics for short exposure times. An initial series of zirconium oxidation runs using an arbitrary flow rate of the gas revealed that the oxide thickness varied along the length of a given specimen and decreased in the direction of the gas flow. Oxidation runs were made at various flow rates in order to establish the conditions which would remove the flow rate as an experimental variable. (auth)

33926 CORROSION BEHAVIOR OF NICKEL–CHROMIUM–IRON ALLOY 600 IN BORATED PRESSURIZED WATER REACTOR ENVIRONMENTS. Van Rooyen, D. (International Nickel Co., Suffern, N. Y.); Copson, H. R.; Berry, W. E. Corrosion, 25: 194-8(May 1969).

Corrosion tests were run for periods up to 5000 hrs in borated water at 600°F in a high velocity loop on strip, tubes, and weldments of Alloy 600. During the first 1000 to 2000 hrs of exposure, corrosion rate differences depending upon surface preparation and in the case of weld metal on composition were observed. However, by 3000 to 5000 hrs, the corrosion rates of all samples tested had decreased to around 1.0 mg/dm^2 per month, or to rates of scale formation of about 1.4 mg/dm^2 per month. Approximately half the scale was adherent, and half was lost to the stream. Comparison with earlier tests in borate-free water seemed to indicate that the addition of boric acid increased corrosion somewhat dur-

ing the initial exposure periods, but this was a transient effect, and corrosion rates decreased with time. (auth)

33927 THE OXIDATION OF TUNGSTEN AT HIGH TEMPERATURES: THE SYSTEM W + CO_2. Cismaru, D.; Geangu-Moisin, Angela (Inst. of Physical Chemistry, Bucharest). Rev. Roum. Chim., 14: 29-34(Jan. 1969).

Studies were made on the oxidation of tungsten from 700 to 1000° in CO_2 at p_{CO_2} = 150 mm Hg. The composition of the oxide scales formed during the oxidation of this metal was determined by x-ray diffraction. The results are different from those obtained at the oxidation of tungsten in air or oxygen. (auth)

33928 PROTECTION OF ZIRCONIUM ALLOY COMPONENTS AGAINST HYDRIDING. (to Atomic Energy of Canada Ltd.). British Patent 1,153,606. May 29, 1969. Priority date Dec. 3, 1965, Canada.

A method is described for reducing the hydriding of components fabricated from zirconium and alloys of zirconium. A sacrificial zirconium alloy portion is provided which protrudes from the component in a way so that the hydrogen can thermally diffuse from the component to the cooler protrusion. (F.S.)

33929 A METHOD OF INCREASING THE CORROSION RESISTANCE OF COBALT-BASED ALLOYS TO MERCURY. Vargo, Edward J. (to United States Atomic Energy Commission). U. S. Patent 3,449,143. June 10, 1969.

A method of inhibiting the corrosion of an alloy containing cobalt, tungsten, chromium, and nickel by hot liquid mercury is described. It comprises contacting the alloy with mercury for a time and at a temperature sufficient to leach chromium and nickel out of the alloy to a depth of several mils and annealing the alloy in hydrogen to convert the surface layer to the intermetallic compound Co_2W. (AEC)

33930 INHIBITION OF URANIUM METAL CORROSION. Sprague, T. P. (to United States Atomic Energy Commission). U. S. Patent 3,460,576. June 17, 1969.

Uranium corrosion problems occurring during the machining of uranium metal were found to be due to the presence of chloride ions in the machining coolant. This corrosion was effectively inhibited by utilizing a machining coolant consisting of water and about 3 to 10 grams of an orthophosphate compound per liter of water. (AEC)

33931 OXIDATION AND CRACKING OF Zr-Cu ALLOYS IN CO_2. Decours, J.; Frenkel, J. M.; Loriers, H.; Baque, P.; Weisz, M. (CEN de Saclay, Gif-sur-Yvette, France). J. Nucl. Mater., 30: 196-207(Apr. 1969). (In French).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

Because zirconium-copper alloys (1.6-2.5 wt % Cu) have shown a high corrosion resistance in carbon dioxide they can be considered as a cladding material in gas-cooled reactors. The weight gain of zirconium in CO_2 is the sum of the mass of the oxygen in the zirconia film and that which has diffused into the metal. The room temperature ductility of a corroded Zr-Cu cylinder which drops to a few per cent after severe corrosion, depends on the thickness of the layer into which oxygen has diffused but is independent of the thickness of the zirconia film. Thermally cycled specimens crack in the oxygen rich metallic zone during cooling. The metal at the bottom of the cracks then oxidizes when the temperature is raised and so the cracks grow with each cycle to the depth of the oxygen-rich embrittled zone. The stresses induced in this oxygen-rich zone during the cooling result from the high temperature relaxation of the compressive stresses caused by the expansion of the metal due to the solution of oxygen. The cracking seems to be related to the creep resistance of the alloy. A heat treatment (beta-quenching and tempering) which greatly improves the creep resistance of the ZrCu alloy suppresses this cracking during the thermal cycling. Irradiation loop tests of fuel bundles have demonstrated that a ZrCu clad fuel element can reach a high burn up at a service temperature of 600°C in a CO_2 atmosphere. (auth)

33932 INFLUENCE OF BOND ENERGIES OF OXIDES ON THE KINETICS OF ANODIC OXIDE GROWTH ON VALVE METALS. Vijh, Ashok K. (Sprague Electric Co., North Adams, Mass.). J. Electrochem. Soc., 116: 972-5(July 1969).

Average bond energy values were calculated for the oxides of Bi, V, U, Y, Nb, Zr, Ti, W, Ta, Al, Hf, and Si from the appropriate thermochemical data. An attempt was made to explore the influence of these bond energies on the magnitude of kinetic parameters for anodic oxide growth on the corresponding metals. It was concluded that, in general, with increasing bond energy, the field required for sustaining a given ionic current density tends to increase, as does the "Tafel slope." Further, the magnitude of the "activation dipole" in Dignam's theory, both for the steady-state and the transient kinetics, tends to decrease with increase in bond energy. Interrelationship of these correlations is briefly pointed out. (auth)

Preparation and Fabrication

Refer also to abstracts 33309-33313, 33972, 33973, 34003, 34004, and 34015.

33933 CASTING TECHNIQUES FOR METALLIC NUCLEAR FUELS. Duerrschnabel, Wolfgang. Z. Metallk., 60: 521-5 (June 1969). (In German).

Published information concerning casting techniques for metallic nuclear fuels is reviewed, and a set-up for the continuous casting of aluminum-uranium alloys containing between 18 and 24 wt % U is described. (auth)

33934 WORK HARDENING. Based on a Symposium Held at Chicago, Ill., November 1966. Hirth, J. P.; Weertman, J. (eds.). Metallurgical Society Conference, Volume 46. New York, Gordon and Breach, Science Publishers, 1968. 391p. $23.50. (CONF-661142).

Seventeen papers were presented at the symposium. A separate abstract was prepared for each of four papers. Papers for which no abstracts were prepared are concerned with fcc single crystals, dislocation structures, hardening stage theories, stress-strain laws, hardening irradiated Al, quenching Cu, hardening Mg-Mn alloys, hardening Ta alloys, hardening iron, hardening Ni_3Al, cph metals, and Frank-Read sources. (J.R.D.)

For abstracts of individual papers see: 33954, 34003, 34004, and 34029.

33935 METHOD FOR THE CONTROLLED ADDITION TO OXYGEN TO COLUMBIUM. Gerber, James D. (Air Force Weapons Test Lab., Kirtland AFB, N. Mex.); Rizzo, Frank E.; Daniels, Raymond D. Trans. Met. Soc. AIME, 245: 1358-60 (June 1969).

A method is given for the addition of small amounts of oxygen to be added to niobium based on the complete reduction by niobium of a carefully weighed amount of another metal oxide. Metal oxides evaluated as potential source materials for introducing O to niobium include Fe-Fe_xO, Fe_xO-Fe_3O_4, Nb-NbO, Cr-Cr_2O_3, Fe_2O_3, and Cu-Cu_2O, Fe-Fe_xO, iron-wuestite mixtures were found to give desired results. (J.C.W.)

33936 FINE-GRAIN TUNGSTEN BY CHEMICAL VAPOR DEPOSITION. Landingham, R. L.; Austin, J. H. (Univ. of California, Livermore). J. Less-Common Metals, 18: 229-43 (July 1969).

A method is described of obtaining fine-grain, non-columnar tungsten (W) by chemical vapor deposition (CVD). Typical CVD tungsten grows columnar grains perpendicular to a heated surface when deposited from its halides, generally WF_6 or WCl_6. The present method involves the partial nitriding of the tungsten to W_2N during deposition and subsequent decomposition of the W_2N. The presence of this second phase (W_2N) alters the growth pattern of the depositing tungsten and eliminates columnar grain growth. (auth)

33937 SOLID PHASE WELDING OF METALS. Tylecote, R. F. New York, St. Martin's Press, 1968. 343p. $18.00.

Information is presented in chapters on history of pressure welding, theoretical considerations, welding techniques and applications, welding conditions for specific metals and alloys, friction welding, high energy-rate welding, ultrasonic welding, and diffusion bonding. (J.R.D.)

33938 INTERMETALLIC COMPOUNDS IN COMPONENTS OF WROUGHT ALUMINUM ALLOYS CONTAINING CERIUM. Korzina, N. S.; Semenov, A. E.; Solov'eva, V. V.; Khodakov, P. E. Alyum. Splavy, Sb. Statei, No. 5, 21-5(1968). (In Russian).

The causes of the formation of intermetallic compounds in the wrought Al alloy V96Ts containing Ce were studied, and their effect on mechanical properties, and on defects during mechanical treatment, is shown. Recommendations are given for preparing the alloy and casting ingots so as to reduce intermetallic inclusions in billets and components. (Referativnyi Zh.)

33939 INVESTMENT CASTING. Thys, Thierry. ASM Technical Paper No. CM68-757. Metals Park, Ohio, American Society for Metals, 1968. 5p.

Standard investment casting practice is reviewed by describing the work of preparing the injection die, the disposable wax pattern, the mold, removing wax from the mold, melting and pouring the metal and finishing the casting. The use of styrene as a pattern material is discussed. The process is adaptable to any castable alloy from Al to steel and a new generation of superalloys which

contain Ti, Zr, and Al and must be poured in a high vacuum, can be cast only by this method. (Metals Abstr.)

33940 PLATINUM–MOLYBDENUM THERMOCOUPLE. Tseng, Y.; Robertson, A.; Zysk, E. D. Engelhard Ind., Tech. Bull., 9: No. 3, 77–84(Dec. 1968).

A Pt–5.0% Mo vs Pt–0.1% Mo thermocouple has been proposed for possible use in a nuclear environment to 1500°C. The experimental technique used to obtain emf vs temperature data on samples from five lots of wire and the numerical methods used to develop a detailed emf vs temperature table in the range of 0 to 1600°C are described. (Metals Abstr.)

33941 STRUCTURAL MEMBER FOR A FAST NUCLEAR REACTOR COOLED BY LIQUID SODIUM. (to Commissariat a l'Energie Atomique). French Patent 1,477,584. Filed Feb. 28, 1966.

A Nb-alloy used for the manufacture of structural members for fast nuclear reactors cooled by liquid sodium, particularly fuel element cans is described. The alloy contains 5 to 10 wt %, preferably 7.5 wt % of Ti and 0.5 to 2.0 wt % preferably 0.75 wt % of Zr, the remainder being Nb and unavoidable impurities. (NPO)

33942 PROCESS FOR THE MANUFACTURE OF NUCLEAR FUEL ELEMENTS. (to United Kingdom Atomic Energy Authority). French Patent 1,464,506. Filed Jan. 19, 1966.

A process is described for the manufacture of a fuel element the outer surface of which is provided with protuberances causing turbulence in the coolant flow. The process comprises filling a thin-walled elongated sheath of a 0.2 mm thick ductile metal or alloy with a finely divided fissile material, compacting the material to 75 to 87% of the theoretical density by compression or vibration, and machining the sheath from one end to the other to cause an inward deformation in the shape of at least one helical groove. Protuberances are formed and the fissile material is compacted to its final density. Different forms of protuberances are shown in an accompanying drawing. An apparatus for effecting said deformation is described in detail. (NPO)

33943 PROCESS FOR THE PRODUCTION OF TUBULAR NUCLEAR FUEL ELEMENTS. (to EURATOM). French Patent 1,414,265. Filed Nov. 10, 1964.

A process for the production of a tubular fuel element which is composed of an inner layer containing graphite and an outer layer containing fissile material is given. The process comprises extruding a mixture of powdered graphite, a polymerizable resin and possibly Si-carbide powder so as to form a cylinder, placing the cylinder in a cylindrical mold, surrounding the cylinder with a mixture of nuclear fuel particles, powdered graphite and a polymerizable resin, compacting the mixture, and heating the unit so as to effect polymerization of the resin contained in the cylinder and the surrounding mixture. (NPO)

33944 PROCESS FOR THE PRODUCTION OF TUBULAR NUCLEAR FUEL ELEMENTS. (to EURATOM). French Patent 1,502,632. Filed Dec. 14, 1965.

A process for the production of a tubular fuel element which comprises an inner and an outer cylindrical layer of different composition is given. A molding press is used provided with an upper and a lower cylindrical cavity having cross-sections corresponding with the shape of the inner and outer layers. Powders of the materials of which the layers are formed, containing a binder, are introduced in the cavities and slightly compacted so as to become self-supporting. The members of the press in which the cavities are provided are then moved in axial direction until the agglomerations are adjacent to one another. Finally the agglomerations are pressed together and heated so as to form a tubular unit. (NPO)

33945 PROCESS FOR PREPARING NUCLEAR FUEL ELEMENTS. (to Japan Atomic Energy Research Inst.). French Patent 1,433,348. Filed Nov. 4, 1964.

A process for preparing nuclear fuel elements in which uranium particles having a diameter less than 5 μ are homogeneously dispersed in a carbon matrix impermeable to volatile fission products and stable against attack by concentrated $HNO_3-H_2SO_4$ mixtures at room temperature is given. The process comprises pouring resin-forming materials to which a uranyl salt has been added into a mold, solidifying the mixture by condensation polymerization in the presence of a small amount of HCl as catalyst to obtain a high polymer resin in which the uranium exists in a chelated state, curing the resin in air and carbonizing it in an inert atmosphere. The temperature is raised gradually until the resin becomes an impermeable body, and the body heated in a H_2-atmosphere until the carbon is graphitized in the degree of 12 to 16%. Preferred data for the heat treatment are given. (NPO)

33946 SOME ESTIMATES ON EXTRUSION. Stuewe, H. P. Metall, 22: 1197–1200(Dec. 1968). (In German).

Yield stresses, loading, energy, heat of deformation, and temperature balance in extrusion are discussed. Values are given for Al, Cu, Pb, Fe, Mg, Zn, and U for extrusion calculations. (M.C.G.)

33947 ELECTRODEPOSITION OF MOLYBDENUM COATINGS. McCawley, Frank X.; Wyche, Charlie; Schlain, David (Bureau of Mines, College Park, Md.). J. Electrochem. Soc., 116: 1028–33(July 1969).

The electrodeposition of coatings of molybdenum from a sodium and lithium metaborate-molybdate-molybdenum oxide fused salt system was investigated. Coatings up to 16 mils thick were deposited on Inconel, Carpenter 20 stainless steel, nickel, copper, and graphite at current densities of 3.1 to 6.2A dm^{-2} (0.2–0.4A $in.^{-2}$) and 900°C under an argon atmosphere. The composition of the electrolyte is critical; deposits are obtained only when the electrolyte contains between 1.0 and 3.3% molybdenum. (auth)

Properties Evaluations

Refer also to abstracts 33176, 33303, 33329, 33355, 33370, 33372, 33378, 33928, 33931, 34003, 34015, 34020, 34038, 34095, 34362, and 34931.

33948 (BNWL–930) EVALUATION OF INCONEL 718 FOR APPLICATION IN THE FAST TEST REACTOR. Moen, R. A.; Wheeler, K. R.; Irvin, J. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Dec. 1968. Contract AT(45-1)-1830. 31p. Dep. CFSTI.

Inconel 718, a precipitation hardenable nickel-base alloy, has recently been considered for use in the Fast Test Reactor (FTR) Properties of interest which qualify this alloy for reactor use are excellent wear resistance, fatigue resistance, ease of fabrication, superior high temperature mechanical properties, and structural stability. Preliminary data have shown Inconel 718 to Inconel 718 to be one of the more favorable material combinations for contact pad use in 1200°F sodium systems. Additional development work required for contact pads involves perfecting methods of fabrication and determining performance of fabricated parts in a 1200°F sodium/neutron environment. Inconel 718 is of interest for spring applications because of its high yield strength at temperature and its superior stress relaxation properties at 1200°F. Further work must be done to determine its corrosion resistance and stress relaxation properties in high temperature-low velocity sodium. As in the spring application, high yield strength at temperature and resistance to stress relaxation qualify Inconel 718 for use as full pin spacers. No data exist at this time, however, on its resistance to corrosion by high temperature, high velocity sodium, nor of the deterioration of strength and ductility resulting from prolonged high temperature exposure in fast neutron environments. Extensive corrosion and stress relaxation tests must be performed in a high fast fluence, high temperature, and high velocity sodium environment. (auth)

33949 (NP–17940) NOTCH TOUGHNESS OF MILD STEEL SUBMERGED ARC WELDS. Report 334. Hughes, Peter Charles (Defence Standards Labs., Maribyrnong (Australia)). Mar. 1969. 25p. Dep.

The notch toughness and metallurgical quality of mild steel submerged arc weld metal were evaluated. Welds are made using conventional acid fluxes and a number of experimental basic fluxes. The Charpy test results demonstrate that significant increases in ductile fracture energy and decreases in transition temperature can be obtained by using basic fluxes. The extent of these improvements varies with the weld metal deoxidation practice used and the metallurgical reasons for this behavior are discussed. (auth) (Australia)

33950 (NP–17941) SPUTTERING OF F.C.C. METALS. Onderdelinden, Dirk (Leiden Rijksuniversiteit (Netherlands)). 1968. 88p. Dep.

Thesis.

Sputtering of fcc metals by ion bombardment is discussed including the influence of lattice structure on the energy transfer of the incoming ions. Typical dependence of the sputtering ratio on parameters like energy, mass, and angle of incidence of the incoming ion is demonstrated. The energy dependence and angular dependence of the ratio are shown for various ions incident on single crystals of Al, Au, Cu, and Pb. Maximums in the curves giving the energy dependence for normally incident ions, shifts towards high energies for heavier ions. Widths of minima are shown to be energy dependent. Interaction potentials used to calculate energy transfer of incoming ions are discussed. A power potential used in differential scattering cross section was derived. An extensive treatment of channeling incident ions is given. A comparison of the energy behavior of the width of the minima found for the sputtering ratio as a function of the angle of inci-

dence and the critical angle for channeling suggests that a channeled particle does not contribute to sputtering. The experimental data were obtained based on the assumptions that the sputtering ratio is proportional to the energy dissipation of the incident beam in a surface layer with x_0 thickness and the channeled part of the beam does not contribute to sputtering. (F.S.)

33951 (NRL-6900) INTEGRATION OF METALLURGICAL AND FRACTURE MECHANICS CONCEPTS OF TRANSITION TEMPERATURE FACTORS RELATING TO FRACTURE-SAFE DESIGN FOR STRUCTURAL STEELS. Pellini, W. S.; Loss, F. J. (Naval Research Lab., Washington, D. C.). Feb. 24, 1969. 70p.

The brittle-to-ductile transition for cleavage fracture of steels has been examined with integrated considerations of micromechanical and macromechanical features. It was found that the analytical capabilities of fracture mechanics are best used by contributions to improved definition of the significance of dynamic fracture toughness tests. For such use, the tests must be indexable to K_{1c} and K_{1d} parameters. The Dynamic Tear (DT) test represents the most advanced engineering test which provides accurate indexing of the true transition temperature range and the specific interval in this range for which fracture mechanics applies. The temperature interval of high fracture toughness which is outside the range of fracture mechanics capabilities is also defined. Size effect can be interpreted and related to expected transition temperature shifts. All of these factors have been integrated into simple reference diagrams which index flaw size-stress relationships for fracture initiation in the transition range. The Fracture Analysis Diagram (FAD) procedure is now extended to cover the full range of thickness. (auth)

33952 (NSEC-4010-1) MOESSBAUER SPECTROMETRY FOR ANALYSIS OF IRON COMPOUNDS. Koch, R. C.; Chow, H. K.; Bogner, R. L. (International Chemical and Nuclear Corp., Pittsburgh, Pa. Nuclear Science Div.). Oct. 1967. Contract AT(30-1)-3673. 62p. Dep. CFSTI.

Metallurgical applications of Mössbauer effect spectroscopy for process development and evaluation, process control, and materials analysis require that the method be directly applicable to a variety of alloys and products having varying dimensions without the need for specialized specimen preparation. The feasibility of satisfying this requirement depends on the adaptation of the principles of the method to a practical system operable in a scattering configuration, capable of accepting existing material surfaces at environmental conditions and yielding the compositional and structural information for which Mössbauer effect spectroscopy is competitively or uniquely suited. It is feasible to design and construct such a Mössbauer effect scattering spectrometer and it is shown that practical industrial requirements exist for the types of measurements which such a system could provide. An experimental program is required to confirm and refine the Mössbauer effect scattering procedures which would provide the desired measurements. (auth)

33953 (Y-1675) PROPERTIES OF TUNGSTEN AND TUNGSTEN ALLOYS FOR REACTOR SHIELDING APPLICATIONS. Watts, T. D. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). June 19, 1969. Contract W-7405-eng-26. 22p. Dep. CFSTI.

Data and information on the chemical, physical, and mechanical properties of unalloyed tungsten and its nickel-iron alloys that pertain to using these materials for reactor shielding have been collected. The normal fabrication techniques and commercial availability are described. Since much of the data were obtained by an extensive literature search, the main references, from which this compilation was made, are included. Most of the information on the tungsten-nickel-iron alloys has come from heretofore unpublished work. (auth)

33954 MICROPLASTICITY IN DUCTILE AND BRITTLE MOLYBDENUM AND MOLYBDENUM ALLOYS. Turk, C. (Texas Instruments, Attleboro, Mass.); Scala, E. Met. Soc. Conf., 46: 333-53(1968).

From Symposium on Work Hardening, Chicago, Ill. See CONF-661142.

The microplastic properties of arc-cast and TZM molybdenum sheet were investigated in tension at room temperature. Plastic strains of 1×10^{-6} in./in. to 1×10^{-4} in./in. were measured with resistance strain gages. Grain sizes were varied from 0.01 to 0.4 mm diameter in order to establish a ductile-to-brittle grain size transition. A two-stage microstrain curve consisting of a region of high work hardening and one of dynamic recovery was found for arc-cast molybdenum. Only a single stage was evident for TZM. The coarse-grained brittle samples exhibited a lower micro-yield point as well as less work hardening in the microstrain region. It is postulated that the work hardening in the brittle samples is caused by the blocking of dislocation sources, while the work hardening in the ductile fine-grained samples is caused by dislocation interactions. (auth)

33955 LOW TEMPERATURE STRAIN AGING IN DEFORMED TANTALUM. Galligan, J. M.; Schultz, H.; Lachenmann, R. (Brookhaven National Lab., Upton, N. Y. Max-Planck-Institut fuer Metallforschung, Stuttgart). Scr. Met., 3: 401-4(June 1969).

Deformation tests were conducted at 78°K on 99.99% pure Ta wires. The specimens were subjected to a fixed plastic strain at 78°K, aged for various times at 160°K, then the flow stress was remeasured at 78°K. It was observed that the strain aging was not associated with the migration of impurity interstitials. Comment concerning possible mechanisms of point defect migration is included and it is noted that the strain aging observed is consistent with dislocation pinning by an intrinsic point defect that migrates at 160°K. (J.R.D.)

33956 THE EFFECTS OF TEMPERATURE AND PRESSURIZATION ON THE TENSILE AND COMPRESSIVE PROPERTIES OF POLYCRYSTALLINE CAST TUNGSTEN. Wronski, A. S.; Chilton, A. C. (Univ. of Bradford, Eng.). Scr. Met., 3: 395-400(June 1969).

Results of tensile tests on specimens prepared from cast W rods are presented. Data are included on the temperature dependencies of the tensile and yield stresses and the brittle fracture stress at 77 to 716°K. Data are also included to illustrate mechanical behavior at 77 to 693°K and to show interstitial impurities. Comment concerning the mechanisms of crack nucleation in which twinning plays a part is presented. (J.R.D.)

33957 THERMODYNAMIC INVESTIGATION OF THE INDIUM-THALLIUM SYSTEM. Predel, B.; Mohs, R. (Univ., Muenster, Ger.). J. Less-Common Metals, 18: 267-74(July 1969). (In German).

The enthalpies of mixing of solid In–Tl alloys at 100°C were determined by solution calorimetry using liquid mercury as the solvent. The values of ΔH^s are positive and their magnitude is, in each case, not much different from that of the enthalpies of mixing in the liquid state ($\Delta H^s_{max} = 130$ cal/g-atom). The excess entropies of the liquid and solid alloys were obtained from the ΔH^s values and the known enthalpies of mixing of liquid In–Tl alloys by evaluating the melting equilibria. The values obtained are very small; they are negative in the case of solid alloys and positive for liquid solutions. A consideration of the factors which determine the energy relationships of the In–Tl system showed that both the change of the chemical bonding upon alloy formation and the atomic misfit as the result of differences in atomic radii are of importance. (auth)

33958 CORRELATION OF Ti-6Al-4V FRACTOGRAPHS WITH MECHANICAL BEHAVIOR IN METHANOL-ACID, METHANOL, AND AIR ENVIRONMENTS. Gegel, H. L. (Air Force Materials Lab., Wright-Patterson AFB, Ohio); Kirkpatrick, H. B.; Swinning, C. M. Corrosion, 25: 215-21(May 1969).

A series of Ti–6Al–4V tensile specimens was tested in air, methanol plus 0.3% of $\frac{1}{10}$ normal HCl, and anhydrous methanol environments at a strain rate of 1.7×10^{-5} sec^{-1}. Fractographic and high resolution electron diffraction examination of the fracture surface provided evidence for the conclusion that Ti–6Al–4V becomes embrittled in an anhydrous methanol environment by a form of hydrogen embrittlement. The fracture mode for the specimens tensile tested in the methanol-acid mixture was characteristic of a low-energy tear process, and the nature of the stress-strain curve suggests that this behavior is due to the Roscoe effect. (auth)

33959 DISCUSSION OF "THE EFFECT OF HYDROGEN ON THE STRUCTURE AND PROPERTIES OF VANADIUM." Loria, Edward A. (National Steel Corp., Weirton, W. Va.). Trans. Met. Soc. AIME, 245: 1366-7(June 1969).

A review of information on factors affecting V ductility is presented. The effects of C, N, O, B, and H are discussed emphasizing the effects of H. Results of research indicate that the presence of hydride alone is not sufficient to cause severe embrittlement; however, H somehow reduces the surface energy and thereby the associated binding energy or cohesion of V. (J.R.D.)

33960 THE EFFECT OF HYDROGEN ON THE STRUCTURE AND PROPERTIES OF VANADIUM. Sherman, D. H.; Owen, C. V.; Scott, T. E. Trans. Met. Soc. AIME, 245: 1367-9(June 1969).

Discussions of research on H interstitials in V are presented. It is noted that grain boundaries are not essential to transformation or embrittlement. Another observation is that yield-load drops and Lüders extension are greater in fine grain than coarse grain material. Comment is included on strain rate effects, sample size and the effects of sample cooling rate. Load-elongation

curves for large grain and small grain material are included. (J.R.D.)

33961 SELF-DIFFUSION OF INDIUM IN LIQUID INDIUM–ALUMINUM ALLOYS. Zamarca, St.; Ganovici, Lucia; Ganovici, I. (Inst. of Physical Chemistry, Bucharest). Rev. Roum. Chim., 14: 35-43(Jan. 1969).

Self-diffusion coefficients of In in homogeneous molten In–5.5 wt % Al alloy have been measured by the capillary-reservoir method on a temperature range from about 748 to 500°. A conventional counting technique was used to determine the ^{114}In content of the integral capillary samples after diffusion. The results indicate that diffusivity of In is affected by clustering in the neighborhood of immiscibility curve since a sensitive deviation of data from the linearity on a log D versus 1/T plot was found. (auth)

33962 CHARACTERISTICS OF ANODIC OXIDE FILMS FORMED ON Nb ALLOYS. Pearson, C.; Wood, G. C. (Univ. of Manchester, Eng.). Corros. Sci., 9: 367-76(June 1969).

The properties of anodic oxide films on Nb–Zr, Nb–W, Nb–Ti, Nb–V and Nb–Mo alloys were studied using V–t curves at constant c.d., optical assessment, ac impedance measurements, and electron probe microanalysis. Good quality films were formed even with 50 at. % additions of non-valve alloying elements. Variations in the residual c.d. after current decay at the final forming voltage, Å/V ratio, dielectric constant and refractive index were qualitatively in agreement with the expected trends. These changes were, however, relatively minor compared with the overall similarity of all the film properties with the properties of films on pure Nb. (auth) (UK)

33963 INFLUENCE OF Mn ON THE HIGH TEMPERATURE OXIDATION RESISTANCE OF A 20 PERCENT Cr–25 PERCENT Ni–Nb STAINLESS STEEL. Antill, J. E.; Peakall, K. A. (Atomic Energy Research Establishment, Harwell, Eng.). Corros. Sci., 9: 431-4(June 1969).

In conjunction with published data it is shown that 0.65% Mn does not significantly influence the long-term oxidation resistance of a 20% Cr–25% Ni–Nb stainless steel in CO_2 at 850°C. Reasons for the apparent discrepancy with the published information are discussed. (auth) (UK)

33964 CREEP OF A DISPERSION STRENGTHENED COLUMBIUM-BASE ALLOY. Klein, Mark J. (International Harvester Co., San Diego, Calif.). Trans. Met. Soc. AIME, 245: 1269-74 (June 1969).

The creep of D43 was studied over the temperature range 1650 to 3200°F and over the stress range 3000 to 44,000 psi. The steady-state creep rate over this range of stress and temperature can be expressed by the equation $\epsilon^0 = Ae^{B\sigma}e^{-H/RT}$ where A is a constant, σ is the stress, and B is $\sim 0.8 \times 10^{-3}$ psi^{-1}. Over a narrow range of stress variations $\epsilon^0 \propto \sigma^n$ and for this proportionality n varies from 3 to 30 in accordance with the relation $n = \sigma B$. Above about 2400°F, H, the apparent activation energy for creep, is 110,000 cal per mole, a value about equal to that estimated for self-diffusion in this alloy. Below 2400°F, H increases with decreasing temperature reaching a value of ~125,000 cal per mole at 1700°F. In this temperature region, H appears to be a function of the interstitial concentration of the alloy. (auth)

33965 ELECTRICAL PROPERTIES OF TITANIUM, ZIRCONIUM, AND HAFNIUM FILMS FROM 300°K TO 1.3°K. Friebertshauser, P. E. (Ford Motor Co., Newport Beach, Calif.); McCamont, J. W. J. Vac. Sci. Technol., 6: 184-7(Jan.-Feb. 1969).

From 15th National Vacuum Symposium, Pittsburgh, Pa. See CONF-681012.

Electrical properties of titanium, zirconium, and hafnium films prepared by electron beam evaporation have been measured from 300 to 1.3°K as a function of substrate temperature, film thickness, and substrate material (single-crystal sapphire, Corning 7059 glass, and fused quartz). Zirconium films in the thickness range 2000 to 12,000 Å have superconductive transition temperatures near 1.3°K for films deposited at substrate temperatures of 100°C and below. Expitaxial growth of titanium is observed on single-crystal sapphire substrates in the temperature range 200 to 400°C on at least two orientations of sapphire. Epitaxial titanium films have a resistance ratio ($R_{300°K}/R_{4.2°K}$) of 24 at a thickness of 12,000 Å and of 8 at 400 Å. This is nearly twice those of the corresponding polycrystalline films on Corning 7059 glass or fused quartz. Films of zirconium and hafnium have an enhanced resistance ratio on sapphire substrates only when deposited at a substrate temperature of 400°C. Their resistivities at 300°K are about twice the bulk values for films 7000 Å thick or greater. Superconductivity was not observed for either titanium or hafnium films down to 1.3°K. Only the hexagonal close-packed crystal structure was found for all three film materials. (auth)

33966 NUCLEAR FUEL ELEMENT CAN. (to EURATOM). French Patent 1,455,584. Filed Nov. 19, 1965.

A fuel element can is described which is composed of a Zr-alloy containing 1.7 to 2.3 at. % of Cr and 0.1 to 0.2 at. % of Fe, the remainder being Zr of commercial quality. Preferably at least part of the Cr is dispersed in the form of $ZrCr_2$-particles having a diameter not exceeding 2 μ in a matrix of α-Zr. After enclosing the fuel in the can the fuel element is introduced into the core region of a nuclear reactor and heated at a temperature in the range 300 to 500°C, the outer surface of the can being subjected to the action of the water and/or the water vapor forming the coolant of the reactor. (NPO)

33967 NUCLEAR FUEL ELEMENT CAN. (to Commissariat a l'Energie Atomique). French Patent 1,476,649. Filed Jan. 20, 1966.

A fuel element can is described which is composed of a Be-alloy containing 0.1 to 5.0 wt % of Cu, the remainder being Be of nuclear purity. In order to prevent intergranular corrosion by moist CO_2 at temperatures exceeding 600°C the can is subjected to the action of a CO_2-atmosphere, preferably containing at least 100 ppM by volume of water vapor, at a pressure not exceeding 100 bars and at a temperature not exceeding 750°C for a time exceeding 4000 hours. (NPO)

33968 MICRODIMENSIONAL INSTABILITY OF METALS. Ingram, A. G.; Hoskins, Mary E. Tool Mfg. Eng., 62: No. 2, 40-3(Feb. 1969).

Both external and internal factors can cause irreversible dimensional changes in metals. The effect of an externally applied load can be determined from a microyield strength test as shown by results for a 2024-T4 Al specimen. The effects of residual stresses can be reduced by stress relief annealing, thermal cycling and stress cycling. Metallurgical stability is promoted by bringing the metal to its thermodynamic equilibrium point. Several materials, including 440C stainless, Ni-Span-C Fe–Ni alloy, A356 cast Al, 2024 and 5456 Al, Ti–5Al–2.5Sn, TZM Mo and several Be alloys have been evaluated for dimensional stability for use in precise instruments. (Metals Abstr.)

33969 KINETICS OF DIFFUSIONAL MOTION OF PORES IN SOLIDS (A REVIEW). Nichols, F. A. (Bettis Atomic Power Lab., West Mifflin, Pa.). J. Nucl. Mater., 30: 143-65(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

Pores have been observed to move bodily within solid materials. Such motion may occur in a more-or-less random manner when no driving forces are imposed on the specimen or it may be biased due to imposed gradients. The possible mechanisms for movement are surface diffusion, volume diffusion through the matrix and volume diffusion through the vapor phase (vapor transport). Important driving forces include: thermal gradient, strain energy gradient, bowed dislocation, curved grain boundary and electric potential gradient (for ionic crystals). A unified treatment for the calculation of driving forces and diffusion-controlled mobilities for the various mechanisms is presented, which points out certain errors and unnecessary complexities introduced by previous authors. Especially highlighted are the complementary approaches using atomic or pore mobilities. Comparisons are then made between the theoretically derived expressions and available experimental observations, both with and without imposed driving forces. There is substantial agreement between theory and experiment. Possible explanations are offered for the apparent discrepancies between theory and experiment, which exist primarily in the cases of no imposed driving forces; in particular, the effects of faceting, dislocations and grain boundaries in impeding pore motion are discussed. (auth)

33970 MELTING OF TUNGSTEN IN A VACUUM ARC FURNACE WITH A CONSUMABLE ELECTRODE. Vasyukov, G. Kh.; Kashin, V. I.; Samarin, A. M. Fiz. Khim. Obrab. Mater., No. 1, 51-7(Jan.-Feb. 1969). (In Russian).

The various factors governing the melting of a consumable W electrode in a vacuum arc furnace (residual pressure in the arc zone, arc current, electrode dia, etc.) under ac and dc conditions are discussed. Melting of the electrode under dc conditions only takes place when the pool of W is in a state of vigorous agitation, i.e., when the residual pressure in the arc zone is no greater than the saturated vapor pressure of molten W at the corresponding temp. The rate of melting is almost independent of residual pressure below 1 torr; it falls with increasing pressure between 1 and 4 torr. Under ac conditions the rate of melting is independent of residual pressure below 10 torr. (Metals Abstr.)

33971 ELASTIC AND ANELASTIC BEHAVIOR OF SEVERAL DELTA-STABILIZED PLUTONIUM ALLOYS AT LOW TEMPER-

ATURES. Rosen, M.; Erez, G. (Nuclear Research Center, Negev, Israel). J. Phys. Chem. Solids, 30: 1063-70(May 1969).

The temperature dependence of the elastic moduli, adiabatic compressibilities, Debye temperatures and ultrasonic wave attenuations of several delta-stabilized plutonium alloys (with aluminum and cerium) was investigated in the range 4.2–300°K. The behavior of the elasticity and anelasticity of these alloys, similar to alpha plutonium, was found to be inconsistent with the antiferromagnetic model. The observed anomalies in the longitudinal wave attenuation in these alloys support the possible existence of a cooperative electron transition in the vicinity of 65°K. It is shown that the cooperative effect is due to the plutonium itself. Alloying additions serve as diluents and weaken the interaction which leads to the cooperative phenomenon. The behavior of both longitudinal and transverse wave attenuations at temperatures above 130°K indicates the possibility of the operation of a thermally activated interband electron transfer. (auth) (UK)

33972 NUCLEAR FUEL ELEMENT CAN. (to Commissariat a l'Energie Atomique). French Patent 1,511,641. Filed Dec. 20, 1966.

A fuel element can is described which is composed of a Mg-alloy containing 0.15 to 0.8 wt %, preferably 0.5 wt %, of Zr and 1 to 5 wt %, preferably 1.3 to 1.7 wt % of Pb, the remainder being Mg. The creep resistance of the alloy may be improved by adding Zn or Ce to the alloy in an amount less than 0.5 wt %. To improve the elastic properties of the alloy, traces of Mn in the range 100 to 200 ppM by weight may be added. The can may be provided with an outer layer consisting of a Mg-alloy containing about 0.5 wt % of Zr. (NPO)

33973 STRUCTURAL MEMBER FOR A FAST NUCLEAR REACTOR COOLED BY LIQUID SODIUM. (to Commissariat a l'Energie Atomique). French Patent 1,473,177. Filed Jan. 20, 1966.

A V-alloy used for the manufacture of structural members for fast nuclear reactors cooled by liquid sodium, is described. A fuel element can of the alloy contains 0.5 to 20 wt. %, preferably 5 wt % of Mo, less than 500 ppM by weight of oxygen and carbon and less than 300 ppM by weight of nitrogen, the remainder being V. Part of the Mo may be replaced by Cr. (NPO)

33974 MECHANICAL PROPERTIES AND STRUCTURE OF INTERNALLY OXIDIZED NIOBIUM–1 PERCENT ZIRCONIUM ALLOY. Bonesteel, R. M.; Rowcliffe, D. J.; Tietz, T. E. (Lockheed Research Lab., Palo Alto, Calif.). Trans. Jap. Inst. Metals, 9: Suppl., 597-602(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

The effects of internal oxidation treatments on the mechanical properties and structure of a niobium-1 atomic percent zirconium alloy were studied. Internal oxidation treatments were performed on 0.040-inch thick sheet material annealed in a vacuum between 10^{-5} and 10^{-6} torr. Under certain annealing conditions of temperature and pressure pronounced strengthening effects were observed. Chemical analyses before and after treatment indicated that oxygen was the main interstitial absorbed during treatment. The temperature for optimum strengthening was determined to be near 800°C; treatments at 750° and 850°C were markedly less effective. The optimum pressure range was 4 to 8×10^{-6} torr, much higher or lower pressures resulted in less strengthening. Annealing treatments for 240 hours at 800°C and 4 to 8×10^{-6} torr resulted in an increase in oxygen content from about 80 ppM to about 1500 ppM. This increase in oxygen content was accompanied by a 5-fold increase in the yield strength and a 4-fold increase in the ultimate strength at room temperature. Similar internal oxidation treatments increased the stress-rupture life at 1200°C by a factor of 250 times over that for the untreated alloy. The internal oxidation treatments resulted in a very uniform, extremely fine dispersion of particles. Strain contrast images indicate these particles are coherent with the matrix and that they are discs approximately 35 Å in width and 10 Å in thickness. All the data suggest that the particles are clusters of zirconium and oxygen atoms. The fact that the strength of the alloy reaches a constant value at approximately 1600 ppM oxygen suggests that no additional zones are being formed as the oxygen content increases beyond this amount. That this occurs at an oxygen content of approximately 1 atomic percent suggests that the zones are composed of equal numbers of zirconium and oxygen atoms. (auth)

33975 EFFECTS OF HYDROSTATIC PRESSURE ON THE MECHANICAL BEHAVIOR OF TUNGSTEN. Das, G.; Radcliffe, S. V. (Case Western Reserve Univ., Cleveland). Trans. Jap. Inst. Metals, 9: Suppl., 334-42(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

The effects of the application of hydrostatic pressure on the dislocation substructure and mechanical behavior observed subsequently at atmospheric pressure, and the influence of high pressure on flow and fracture were investigated for polycrystalline powder metallurgy tungsten and similar material containing second phase additions of thoria and hafnium carbide. Tensile tests were conducted from 25 to 250°C at atmospheric pressure on specimens subjected previously to pressures up to 25 kilobars and at room temperature during subjection to pressures up to 11 kilobars. The sub-structures were examined by optical and transmission electron microscopy. The ductile-brittle transition behavior of recrystallized tungsten and a tungsten-1.9 vol % thoria alloy are essentially unaffected by pressure cycling up to 25 kilobars at atmospheric temperature. The results for tungsten are in keeping with the scarcity of impurity particles observed and the corresponding absence of pressure-induced dislocations. In tungsten containing additions of second phase particles (ThO_2 or HfC) a similar absence of induced dislocations was found for pressures up to 25 kilobars, but new dislocations were observed at particles after subjection to pressures of some 40 kilobars. The stress-strain behavior of recrystallized tungsten at constant pressure and atmospheric temperature changes progressively as the environmental pressure in increased. Initially, fracture with no measurable plastic deformation persists, but the fracture stress increases with increasing pressure and, at sufficiently high pressures, a distinct yield drop followed by a substantial plastic deformation and work hardening is developed. The magnitude of the resulting lower yield stress (96,000 psi) is in agreement with the extrapolation to room temperature of the temperature dependence of the yield stress of recrystallized powder metallurgy tungsten as measured at higher temperatures at atmospheric pressure by several different workers. The dislocation substructures developed during plastic straining at high pressure are different from those reported previously for polycrystalline tungsten subjected to similar amounts of plastic strain at higher temperature and atmospheric pressure and the fracture mode is a combination of intergranular separation and transgranular cleavage. The implications of these results for the interpretation of the discontinuous yield phenomena in tungsten and the fracture process are discussed. (auth)

33976 AGING OF IRON–CHROMIUM AND IRON–CHROMIUM–VANADIUM ALLOYS AT ABOUT 500°C. Mima, G.; Yamaguchi, M.; Takahashi, J. (Osaka Univ.). Trans. Jap. Inst. Metals, 9: Suppl., 407-12(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

An investigation of the aging at about 500°C of iron-chromium and iron-chromium-vanadium alloys was carried out using transmission electron microscopy. Fine precipitates which have been known to be formed in the aging of the iron-chromium alloys due to the existence of a miscibility gap can be also observed in an iron-17 at. % chromium-7 at. % vanadium alloy and an iron-12 at. % chromium-12 at. % vanadium alloy aged for 200 days at 480°C. The interactions between dislocations and the fine precipitates in the aged iron-24 at. % chromium alloy are very similar in appearance to the interactions observed in aluminum alloys containing G. P. zones. Dislocations in the aged alloys cannot easily cause cross slip and therefore a large number of dislocations are confined to one slip plane and may build up a high stress concentration which is directly related to the embrittlement of these aged alloys. (auth)

33977 WORK-HARDENING MODEL FOR THE EFFECT OF GRAIN SIZE ON THE FLOW STRESS OF NIOBIUM STRAINED BY ROLLING. Conrad, H. (Univ. of Kentucky, Lexington); Feuerstein, S.; Rice, L. A. Trans. Jap. Inst. Metals, 9: Suppl., 481-7(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

Effect of grain size in the range of 32 to 435 μ on the dislocation density and structure and the flow stress of 125-μ niobium foil rolled various amounts at room temperature was investigated. For a given grain size d the dislocation density increased in an approximately linear manner with the rolling reduction, the rate of increase being proportional to d^{-1}. The shear flow stress τ increased with the square root of the dislocation density independent of grain size in accord with the relation $\tau = \tau_f + 0.60Gb\rho^{\frac{1}{2}}$. Effect of grain size on flow stress is thus explained in terms of a workhardening model based on long-range stress fields of dislocations, rather than a Hall–Petch pile-up model. The strain at which a well-defined cellular network of dislocations first developed increased with an increase in grain size. Once the cell structure formed, the cell size tended to decrease with further straining. The cell size at a rolling reduction of 10% varied approximately as $d^{\frac{1}{2}}$. The results on the rolled niobium foil are compared with those obtained on identical material strained in

tension. Although there are some differences between the two methods of straining, the general behavior is similar. (auth)

33978 WORK HARDENING AND DISLOCATION STRUCTURES IN NIOBIUM SINGLE CRYSTALS. Orava, R. N. (Denver Research Inst.); Lawley, A.; Conrad, H. Trans. Jap. Inst. Metals, 9: Suppl., 488-96(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

Tensile stress-strain relationships and associated dislocation structures have been studied in zone refined niobium single crystals as a function of temperature (298 to 77°K) and strain. Distinct three-stage hardening is observed for temperatures between 0.1 ~ 0.2 of the melting point for initial orientations giving rise to slip on a system of the type {011} ⟨111⟩. At a given level of shear strain (~0.1) decreasing the test temperature leads to an increase in the density of primary and secondary dislocations, dislocation loops, and dipoles. The extent of tangling increases with an associated decrease in tangle spacing. These observations are consistent with other concurrent studies on niobium, tantalum, molybdenum, and iron, in that the lower temperature limit for distinct three-stage hardening is approximately equal to that at which the thermal component of the flow stress is small or zero. A qualitative interpretation of three-stage hardening is outlined, based on the known dislocation configurations in body centered cubic metals and alloys. (auth)

33979 TWINNING AND THE LOW TEMPERATURE MECHANICAL PROPERTIES OF POLYCRYSTALLINE COLUMBIUM, MOLYBDENUM, AND NbMo ALLOYS. Shaw, Bevil J. (Westinghouse Research Labs., Pittsburgh). Trans. Jap. Inst. Metals, 9: Suppl., 551-4(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

Mechanical tests in compression and tension over a range of temperatures embracing the ductile-brittle transition temperature were done on irradiated and non-irradiated molybdenum and three alloys of NbMo. Stress relaxation tests in conjunction with these were interpreted to show that slip and twinning are probably not involved in the initiation of fracture in very brittle materials. It is also deduced that irradiation damage and alloying act in a similar manner in inhibiting slip and twinning. (auth)

33980 CREEP OF BERYLLIUM SINGLE CRYSTALS COMPRESSED ALONG THE C AXIS. Le Hazif, R.; Antolin, J.; Dupouy, J. M. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Trans. Jap. Inst. Metals, 9: Suppl., 247-51 (1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

Previous compression tests of beryllium single crystals had shown that there was no significant amount of pyramidal glide in a direction out of the basal plane in this metal up to 600°C. Therefore, when single crystals are compressed along the c axis, there is no available slip or twinning mode. The presence, after compression, of numerous dislocations of Burgers vector $\bar{c}$, in the basal planes was noticed. It is then thought that the specimens can deform by climb of these $\bar{c}$ dislocations, which cannot glide. This climb is caused by the flow of vacancies arriving to the dislocation, around which locally, the equilibrium concentration of vacancies is less than the concentration in the crystal without applied stress. Creep tests were made in compression at 350 to 500°C with stresses of 30 to 80 kg/mm^2. The creep rate is continuously increasing. The activation energy is of the order of the self diffusion energy and the creep rate varies as $\sigma^{3.5}$. The electron microscope observations have shown that the $\bar{a}$ dislocations climb and that the number of $\bar{c}$ dislocations increases from less than 10^4 to 10^8/cm^2 for a deformation of 20%. The creep is governed by the multiplication of the $\bar{c}$ dislocations and by the flow of vacancies. It was shown that creep rates determined by a diffusion model are compatible with observed creep rates. (auth)

33981 LONG RANGE ORDER AND THE GRAIN BOUNDARY STRENGTHENING OF Fe–49 PERCENT Co–2 PERCENT V. Jordan, K. R.; Stoloff, N. S. (Rensselaer Polytechnic Inst., Troy, N. Y.). Trans. Jap. Inst. Metals, 9: Suppl., 281-7(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

The grain size dependence of the yield, flow and fracture stresses of an Fe-49%Co-2%V alloy has been determined over the temperature range –196 to 25°C. The yield and flow stresses obey the Petch relation: $\sigma = \sigma_i + kd^{-\frac{1}{2}}$ where σ is the yield or flow stress, σ_i is a friction stress which increases with strain, k is a measure of grain boundary resistance to slip propagation and d is the grain diameter. The value of σ_i appropriate to yielding is markedly decreased by long range order, while k_y increases. The temperature dependence of k_y is greater for the ordered condition. The fracture stress does not vary linearly with $d^{-\frac{1}{2}}$, independent of order. Surface slip band and electron transmission microscopy observations reveal no correlation between ease of cross slip and the temperature dependence of k_y in either ordered or disordered FeCo-V. Moreover, ordered FeCo-V deforms by slip on {211} and {321} as well as {110} planes, and gives evidence of frequent cross-slip. The relevance of these observations to flow and fracture properties is discussed. (auth)

33982 INTERACTION OF INTERSTITIAL IMPURITIES WITH DISLOCATIONS IN GROUP Va METALS. Schlaet, F. (Deutsche Akademie der Wissenschaften, Berlin, Institut fuer Metallphysik und Reinstmetalle, Dresden). Trans. Jap. Inst. Metals, 9: Suppl., 64-7(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

The torsional recovery of plastically twisted tantalum and niobium wires was investigated during annealing in the temperature range from 10 to 700°C. It is shown that the interstitial oxygen and nitrogen atoms strongly affected this process according to the different types of their interaction with dislocations. Some correlations between the untwisting processes and the cold-work peaks of internal friction were found. The results imply that the cold-work peaks are caused by movement of dislocations together with their impurity atmospheres as proposed by Schoeck. The unstability and annealing behavior of the cold-work peaks can be explained by locking of dislocations by interstitial impurities of low mobility and rearrangement of dislocations. (auth)

33983 STRENGTH OF Zr-2½% Nb ALLOY IN THE ANNEALED AND COLD WORKED CONDITION. Winton, J.; Murgatroya, R. A.; Watkins, B.; Nichols, R. W. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). Trans. Jap. Inst. Metals, 9: Suppl., 630-6(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

The use of cold worked Zr-2½% Nb alloy as intermediate strength components in water reactors is discussed. The tensile and creep properties of actual pressure tube material are presented and compared with those of cold worked Zircaloy-2. The 20% cold worked Zr-2½% Nb pressure tube material has a clear strength advantage relative to comparable Zircaloy-2 material of about 10 to 20000 psi at 20 to 300°C. In the autoclaved condition, that is, after heating at 400°C for 3 days, this advantage is increased by a further 10000 psi for whereas the Zircaloy-2 softens during the process, the 2½% Nb alloy increases in strength. An electron microscope study of the structure of the 2½% Nb alloy has shown that the increase in strength during autoclaving is at least partly due to further precipitation of a Nb-rich phase in the supersaturated α-Zr phase. The relative effects of Nb content, O content and cold work in promoting strengthening have also been demonstrated on a series of various Nb and O contents. The rate of increase in UTS value at 300°C is 6000 psi/1% Nb and 6000 psi/1000 ppM O while the strengthening due to cold work is not significant above 20% reduction. (auth)

33984 ON STRUCTURAL FACTORS INFLUENCING THE STRENGTH OF MARTENSITIC α' IN QUENCHED Zr-2.5% Nb. Williams, C. D.; Gilbert, R. W. (Chalk River Nuclear Labs., Ont.). Trans. Jap. Inst. Metals, 9: Suppl., 625-30(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

A cph martensitic phase, α', is obtained when the bcc β-Zr phase is rapidly quenched. The form of the martensitic product is determined by the solute concentration and the cooling rate; a twinned product is formed at cooling rates >1000°C per second in alloys containing >0.6 wt % Nb, and a slipped martensite and non-martensitic product replace the twinned α' as the solute concentration and/or cooling rate is progressively reduced. Examination of the structural characteristics of the β transformation products and their properties shows that twinned martensite is harder and has a higher tensile strength than slipped martensite. In an alloy containing 2.5 wt % Nb and 0.11 wt % O the solutes and microtwinning make similar contributions to the as-quenched strength, the major contribution being due to the small size of the plates produced by the transformation. (auth)

33985 THERMAL STABILITY OF ALPHA + BETA TITANIUM ALLOYS. Yukawa, T.; Ohtani, S.; Sakai, T. (Kobe Steel, Ltd., Japan). Trans. Jap. Inst. Metals, 9: Suppl., 656-8(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

Although titanium alloys are commonly used at temperatures up to 400°C, the thermal stability at temperature above 500°C, which means an ability to maintain their room temperature properties even after exposure at such elevated temperatures, is worth studying. To obtain information about the effect of beta

stabilizing elements on thermal stability at a temperature above 500°C of alpha-beta titanium alloys, Ti-5 wt % Al alloy containing 1 wt % beta-stabilizers like Mo, Fe and Cr, commercial Ti-5 wt % Al alloy containing Fe + Cr and typical alpha + beta titanium alloy Ti-6Al-4V were examined. (auth)

33986 DUCTILITY OF COLDWORKED, ANNEALED, AND RECRYSTALLIZED STATES IN ALPHA URANIUM. Guillaume, C.; Lions, M. (Commissariat a l'Energie Atomique, Paris). Trans. Jap. Inst. Metals, 9: Suppl., 659-66(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

A study of the ductility of alpha uranium was made on specimens cold-rolled either by unidirectional or cross-rolling and annealed at various temperatures. Tensile tests carried out at room temperature show, all parameters being kept constant, that the partially recrystallized structures are more ductile than the recrystallized ones. In partially recrystallized structures there is also a difference in ductility and work-hardening between the transverse and rolling directions in unidirectional rolling, and even between the two rolling directions in cross-rolling. These results are interpreted in terms of structure, texture, deformation mechanisms and fracture modes. (auth)

33987 INFLUENCE OF THERMOMECHANICAL TREATMENTS ON THE STRENGTH, HIGH TEMPERATURE STABILITY, AND MICROSTRUCTURE OF HASTELLOY X-280. Levy, I. S. (Battelle Memorial Inst., Richland, Wash.). Contract AT(45-1)-1830. Trans. Jap. Inst. Metals, 9: Suppl., 667-71(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

Specimens of Hastelloy X-280, a low-cobalt version of the solid-solution-hardened nickel-base alloy Hastelloy X, were given a series of thermomechanical treatments, after which they were exposed at either 540°F for 450 hrs or 1250°F for more than 1500 hrs. The specimens were then subjected to tensile and creep-rupture tests at 1350°F and to microstructural examinations. Creep-rupture tests on specimens exposed at 540°F showed that reductions in creep rates of up to a factor of 14 occurred as a result of these treatments. This strengthening resulted from the dislocation networks and precipitates produced by the treatments. Tensile tests on specimens exposed at 1250°F showed a general increase in strength and decrease in uniform elongation with increasing cold work levels in the treatments. One treatment produced a 25% increase in yield strength with little loss in ductility relative to the standard treatment. Microscopy showed that this was due to dislocation tangling, which had not been eliminated by the exposure, and to the precipitates developed by treatments. A comparison of the tensile data for the 540 and 1250°F exposures revealed that the 1250°F exposure produced a general increase in yield strength and decrease in uniform elongation relative to the 540°F exposure. Microscopy showed this to be due to hardening by precipitates that formed during the 1250°F exposure. Some of the thermomechanically treated specimens incurred much less strength increase and ductility loss after this exposure than did the standard-treated specimens. Microscopy revealed that this better stability was a result of the extensive precipitation that formed during the treatments which led to microstructures that were less susceptible to further precipitation during the 1250°F exposure. (auth)

33988 EFFECTS OF IMPURITIES ON THE PLASTIC FLOW OF MOLYBDENUM CRYSTALS. Whitmire, L. D. (Esso Production Research Co., Houston, Tex.); Brotzen, F. R. Trans. Jap. Inst. Metals, 9: Suppl., 867-70(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

Molybdenum crystals were grown in various degrees of purity by the electron-beam zone-melting method. The ratio of electrical resistance at 273°K to that at 4.2°K was used as a measure of the differences in purity among the crystals. The range of resistance ratios extended from about 500 to 7000. Flow stress and activation volume were determined as functions of strain, strain rate, and temperature between 78 and 400°K. All testing was carried out in direct shear on the $(1\bar{1}0)-[111]$ system. The flow stress at low temperatures or at high strain rates was particularly sensitive to the resistance ratio and, therefore, presumably to the impurity content. At 250°K the impurity effect was noticeable mainly in the early stages of deformation. Above 300°K the stress-strain curves showed the features characteristic of three-stage hardening obtained with face-centered cubic metals. The easy-glide region could be detected only in the purest of crystals. The activation volume decreased with strain at all temperatures. At low temperatures, a relatively high impurity content (i.e., a low resistance ratio) lowered the activation volume, but this effect tended to vanish as deformation proceeded to greater strains. Raising the temperature diminished the impurity effect on the activation volume, and the effect became altogether undetectable at larger strains. At 400°K the activation volume varied with strain in a manner which correlated with the three-stage stress-strain diagrams obtained at this temperature. It is suggested that impurities in molybdenum, even when present only in relatively low concentrations, affect the slip distance of dislocations in the early stages of deformation, thereby tending to suppress the easy-glide stage. With progressing strain, the impurity effect on the activation volume vanishes. This, as well as the very small values of the activation volume, indicates the prevalence of a mechanism that involves obstacles to dislocation motion other than impurities. (auth)

33989 PRISMATIC SLIP IN ZIRCONIUM. Levine, E. D. (Kennecott Copper Corp., Lexington, Mass.). Trans. Jap. Inst. Metals, 9: Suppl., 832-6(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

A study was made to delineate the dislocation mechanisms that control the operation of prismatic slip in hcp-zirconium at low temperatures. Experiments were performed on single crystals containing approximately 150 ppM interstitial impurities in order to compare results with those reported in the literature for both higher and lower impurity concentrations. Measurements were made of τ^*, the thermal component of the critical shear stress, and of ν^*, activation volume. A single thermally activated dislocation process controls the initiation of prismatic slip at temperatures below 450°K. At low temperatures, τ^* is intermediate to values reported for higher and lower impurity levels, confirming the operation of an impurity-controlled mechanism. The variation of τ^* with concentration, the temperature dependence of τ^*, the stress dependence of activation energy, and the stress dependence of ν^* are all in agreement with Fleischer's theory of strengthening by the interaction of dislocations with tetragonal lattice distortions caused by interstitial atoms. (auth)

33990 PRISMATIC SLIP IN BERYLLIUM. Regnier, P.; Dupouy, J. M. (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Trans. Jap. Inst. Metals, 9: Suppl., 826-31 (1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

The yield stress of single crystals of beryllium oriented for single prismatic slip varies with temperature as follows: it decreases from 3.75 kg/mm^2 at −196°C to 2.7 kg/mm^2 at −100°C, then increases to 5.6 kg/mm^2 at +60°C and finally decreases. This anomalous variation has not been observed by previous authors because of the orientation of the specimens they used. The effect of impurities is ruled out because of several considerations. It is shown that above −100°C, the measured stress is not a real elastic limit but a flow stress which is preceded by a deformation stage with a very high hardening rate. Possible explanations for the observed facts are discussed. At low temperatures, deformation occurs by pure prismatic slip from sources in the prismatic plane. Above −100°C, prismatic sources get blocked by a thermally activated mechanism which is probably the dissociation in the basal plane of screw dislocations. The activated barrier could be the formation of the nucleus of fault or the necessity of constricting dislocations dissociated in the prismatic plane. The latter assumption could also explain the shape of the stress-strain curves. (auth)

33991 PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON THE STRENGTH OF METALS AND ALLOYS, TOKYO, JAPAN, SEPTEMBER 4–8, 1967. Trans. Jap. Inst. Metals, 9: Suppl., 1-1038(1968). (CONF-670909).

Thirty-five papers were selected as being in scope of NSA. Separate abstracts are included for each. (TSS)

For abstracts of individual papers see: 33974–33990, 34020, 34046–34055, 34104–34109, and 34362.

33992 KINETICS OF GASSING AND DEGASSING OF GROUP VA METALS. Hoerz, G. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Metall, 22: 1201-5(Dec. 1968). (In German).

Kinetics of degassing of V, Nb, and Ta were investigated. Adsorption of O_2 and N_2 by these metals was also studied. Energy ratios for gassing and degassing are discussed. (M.C.G.)

Structure and Phase Studies

Refer also to abstracts 33350, 33974, 33987, 34026, 34032, 34034, and 34042.

33993 (CALT-221-67) STRUCTURE AND MAGNETIC PROPERTIES OF RAPIDLY QUENCHED Sm-TYPE ALLOYS.

Speight, J. D. (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). May 1969. Contract AT(04-3)-221. 27p. Dep. CFSTI.

The results of rapid quenching experiments on Sm-type alloys in the gadolinium-lanthanum, gadolinium-cerium, gadolinium-praseodymium and gadolinium-neodymium binary systems are reported. The alloys were examined to study the effect of rapid quenching on the Sm-type crystal structure and the effect of quenching on the magnetic properties of the alloys. (auth)

33994 (NLCO-1040) SUMMARY TECHNICAL REPORT FOR THE PERIOD JANUARY 1–MARCH 31, 1969. Burgett, R. (ed.) (National Lead Co. of Ohio, Cincinnati). May 1969. Contract AT(30-1)-1156. 18p. Dep. CFSTI.

Ingots with small, medium, and large equiaxed grain structures and with small, medium, and large dendritic grain structures were rolled to 1½-inch diameter rods. Uranium rods rolled from ingots with either small or large equiaxed grain structures had shallower defects than rods rolled from ingots with dendritic grain structures. No effect of ingot grain size on rod defect depth was detected. Tests were made to evaluate the effect of variations in environmental relative humidity on the quantometric determination of 22 impurities in U_3O_8. Varying the relative humidity from 46% to 37% caused variations in analytical results ranging from negligible to more than 100%. Uranium-base alloys containing small quantities of Fe, Si, and Al were analyzed for ^{235}U with a mass spectrometer. The alloying additives were found to have a negligible effect on isotopic results. (tr-auth)

33995 (SGAE-M-22/1968) DENDRITIC GROWTH OF Mo, Nb, AND Ta ON DEPOSITION FROM THE GAS PHASE. Koss, P.; Rotter, K. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Institut fuer Metallurgie). 1968. 20p. (In German). (CONF-680603-5). Dep.

From 6th International Plansee Seminar on High Temperature Materials, Fundamental and Developments, Reutte, Tirol, Austria.

The preparation of metallic Mo, Nb, and Ta from the gas phase by hydrogen reduction of the pentachloride was investigated. The halogenides were evaporated at about 100°C and reduced in H_2 atmosphere at temperatures over 500°C. The dependence of the deposition rate and the growth form on the deposition parameters were determined. Under certain conditions a dendrite growth occurs which is not completely explained by present theories on crystalline growth. Special consideration was given to this dendrite growth and its deposition conditions. (tr-auth)

33996 CRYSTAL STRUCTURE OF THE COMPOUND $Nb_2Cr_4Si_5$: THE THETA PHASE OF THE NIOBIUM–CHROMIUM–SILICON SYSTEM. Kripyakevich, P. I.; Yarmolyuk, Ya. P.; Gladyshevskii, E. I. (Lvov State Univ.). Sov. Phys.-Cryst. (Engl. Transl.), 13: 677-81(Mar.-Apr. 1969).

Translated from Kristallografiya, 13: 781-6(Sept.-Oct. 1968).

The crystal structure of the θ phase of the Nb–Cr–Si system has been determined completely by the x-ray structural method. The structure constitutes a new type. In the orthorhombic unit cell (a = 7.51, b = 15.83, c = 4.92 Å) at the composition $Nb_2Cr_4Si_5$, the atoms occupy the following positions (space group Ibam – D_{2h}^{26}): 8 Nb in 8 (j)xy0 with x = 0.117, y = 0.142, 8 Cr^1 in 8 (j) with x = 0.245, y = 0.439, 8 Cr^2 in 8 (g) 0 y ¼ with y = 0.307, 8 Si^1 in 8 (j) with x = 0.299, y = 0.288 8 Si^2 in 8 (j) with x = 0.423, y = 0.065, 4 Si^3 in 4 (a) 00¼. The structure of $Nb_2Cr_4Si_5$ contains densely populated networks based on hexagons, quadrangles, and triangles, alternating with sparsely-populated intermediate layers; as regards the coordination of the atoms it is closest to the W_5Si_3 type of structure. (auth)

33997 PHASE TRANSFORMATIONS IN U–Cr ALLOYS. Bar-Or, A.; Kimmel, G. (Nuclear Research Centre, Negev, Israel). pp 248-53 of Mechanism of Phase Transformations in Crystalline Solids. London, Institute of Metals, 1969.

From Symposium on Mechanism of Phase Transformations in Crystalline Solids, Manchester, England. See CONF-680718.

Rates of growth of pearlite, bainite, and martensite in U–Cr alloys were determined. Good agreement between Turnbull's theoretical formulas for growth rate and the bainite experimental results indicated that the growth of bainite is controlled by the interface atom jumps, for both lateral and longitudinal directions. Extrapolation of the growth-rate results from the bainite into the pearlite range showed surprisingly close agreement with growth-rate measurements of pearlite, suggesting that an identical mechanism controls both. The good agreement between Turnbull's formulas for rate of growth and the experimental results in martensite leads also to the proposal that the rate of growth for martensite plates in U–Cr alloys is controlled by interface movement, itself controlled by individual atom jumps. It is suggested that growth of martensite takes place in two steps: the rate-controlling step and an intermittent second step in which a certain proportion of atoms cross the interface by a cooperative process. (auth) (UK)

33998 TRANSFORMATION KINETICS OF THE $\beta \rightarrow \alpha$ PHASE CHANGE IN A URANIUM–CHROMIUM–MOLYBDENUM ALLOY. Haberlin, M. M.; Slattery, G. F. (United Kingdom Atomic Energy Authority, Springfields, Eng.). pp 254-9 of Mechanism of Phase Transformations in Crystalline Solids. London, Institute of Metals, 1969.

From Symposium on Mechanism of Phase Transformations in Crystalline Solids, Manchester, England. See CONF-680718.

The $\beta \rightarrow \alpha$ transformation in a uranium–0.25 at. % chromium–0.5 at. % molybdenum alloy was studied at temperatures down to 300°C by dilatometry, metallography, hardness, and x-ray diffraction. A detailed analysis of the kinetics of transformation was made. The TTT diagram was derived by dilatometry and found to consist of two C curves. The upper C curve was predominantly associated with a diffusion-controlled transformation, but the associated metallographic, hardness, and x-ray results would suggest a subdivision of this upper C region at a temperature in the range 480–510°C. The intermediate mechanism of transformation is probably of a bainitic type and extends down to ~425°C. The low-temperature C curve appears to involve a shear-type transformation. (auth) (UK)

33999 A NOTE ON THE DEPENDENCE OF THE LOW-TEMPERATURE MARTENSITIC TRANSFORMATION IN Nb_3Sn ON COMPOSITION. King, H. W. (Imperial Coll. of Science and Tech., London. Univ. of California, Berkeley). pp 196-7 of Mechanism of Phase Transformations in Crystalline Solids. London, Institute of Metals, 1969.

From Symposium on Mechanism of Phase Transformations in Crystalline Solids, Manchester, England. See CONF-680718.

In the investigation on Nb_3Sn, x-ray diffraction patterns of alloys of various compositions were studied. Broadened profiles indicative of the tetragonal martensite were observed only in alloys with room temperature lattice parameters between 5.2867 and 5.2908 Å. The reverse transformation (martensite $\rightarrow \beta$-W) was also followed by warming samples from 6.5°K and scanning the 432 diffraction line profile. Martensitic transformation temperatures and superconducting transition temperatures are shown graphically as functions of the room temperature lattice parameters of β-W-Nb_3Sn alloys, together with a composition scale. The results indicate that, although the β-W structure is present from ~20 to 26 at. % Sn, the martensite is limited to the composition range 22.7 to 25.1 at. % Sn. The asymmetry of the curves about the stoichiometric composition is discussed in terms of the different environments of the sites for the Nb and Sn atoms. The dependence on composition of the martensitic transformation and the known trends in superconducting transition temperature in Nb_3Sn alloys are also briefly discussed. (UK)

34000 CRYSTALLOGRAPHY OF MARTENSITIC TRANSFORMATIONS IN URANIUM AND ITS ALLOYS. Crocker, A. G.; Ross, N. D. H. (Univ. of Surrey, Eng.). pp 176-80 of Mechanism of Phase Transformations in Crystalline Solids. London, Institute of Metals, 1969.

From Symposium on Mechanism of Phase Transformations in Crystalline Solids, Manchester, England. See CONF-680718.

The importance of both the $\beta \rightarrow \alpha$ and the $\gamma \rightarrow \alpha$ transformations in uranium and its alloys as critical tests of theories of martensite crystallography is emphasized. It is shown that many possible correspondences exist relating the β and α structures, but further detailed experimental information is necessary before definite conclusions can be drawn about their operation in practice. Such information is available for the $\gamma \rightarrow \alpha$ transformation, but in this case it is demonstrated that for some observed cases the theories have no real solutions. This shows that current theories of martensite crystallography are inadequate. A new theory of transformation shears is therefore being developed and a preliminary account of this is given. (auth) (UK)

34001 MECHANISM OF PHASE TRANSFORMATIONS IN CRYSTALLINE SOLIDS. Proceedings of an International Symposium Held at Manchester, Eng., 3–5 July 1968. Monograph and Report Series No. 33. London, Institute of Metals, 1969. 324p. 120s. (CONF-680718).

Sixty seven papers presented at the conference are arranged under the following topics: spinodal decomposition, precipitation, particle coarsening, martensite, order-disorder, interface-controlled transformations, and theory of transformations. A separate abstract was prepared for each of 4 papers. (M.C.G.)

For abstracts of individual papers see: 33997–34000.

34002 CONTRIBUTION TO THE STUDY OF THE PHASE DIAGRAM FOR THE SYSTEM Cu–Nb. Allibert, Colette; Driole, Jean; Bonnier, Etienne (CNRS–ENSEEG, Grenoble, France). Compt. Rend., Ser. C, 268: 1579-81(May 5, 1969). (In French).

Results of studies on the equilibrium diagrams for Cu-Nb-Ta and Cu-Nb-W were not satisfactory because of the inadequate understanding of the diagram for the binary system Cu-Nb. New liquidus and solidus curves for the Cu-Nb system is presented. They were obtained by complete thermal analysis using a 10 kHz, 30 kVA furnace heated by low-frequency induction. Liquidus and solidus temperatures are given for 13 samples from 1.4 to 79.8 at. % Nb. The solidus temperature was 1090°C over this range; the liquidus temperature varied from 1260 to 1920°C. (R.C.K.)

34003 WORK-HARDENING CHARACTERISTICS OF Ta AND Ta-BASE ALLOYS. Arsenault, R. J. (Univ. of Maryland, College Park); Lawley, A. Met. Soc. Conf., 46: 283-309(1968).

From Symposium on Work Hardening, Chicago, Ill. See CONF-661142.

The work hardening characteristics of Ta and Ta-base-alloy single crystals were investigated as a function of temperature and interstitial concentration. The dislocation structures formed at various temperatures and stages of work hardening were examined in samples cut parallel and perpendicular to the primary slip vector. One of the significant observations was the dependency of Stage II and value of θ_{II} on the magnitude of the effective stress τ^*. Another unique observation, in contrast to those on fcc metals and solid solutions, is the large degree (10°) of overshoot that could occur prior to any deviation in the rotation of tensile axis that is indicative of secondary slip, and prior to the observation (optically) of secondary slip traces. It appears that a necessary condition for the existence of Stage II is the presence of secondary slip traces. It was also observed that the activation volume is larger in Stage II than Stage I, whereas in fcc metals the opposite is observed. An explanation of the dependency of Stage II and θ_{II} on the magnitude of τ^* was based on a greater probability for the following stable reaction $a/2\ [11\bar{1}] + a/2\ [1\bar{1}1] = a\ [100]$ to occur at small effective stresses, and the necessary increase in the internal stress before the secondary system becomes operative is less at small effective stresses. This reasoning is found to be consistent with the observed dislocation substructures; the latter were characterized in the presence and absence of Stage II hardening. Diffraction contrast experiments allowed for a determination of the relative amounts of primary and secondary slip at the various levels of strain. From the data obtained on the effect of solute additions on the work hardening characteristics, it was found that an increase in solute concentration, either interstitial or substitutional, will eliminate the three stages of work hardening or reduce the rate of work hardening in Stage II. An increase in the interstitial concentration will result in the grown-in dislocations becoming tightly locked and/or the formation of interstitial precipitates that will act as barriers and induce secondary slip immediately upon straining. The addition of substitutional atoms can also lock the grown-in dislocations such that grown-in dislocations will act as barriers (tungsten) or reduce the number of operative sources on the secondary slip systems (niobium). (auth)

34004 DISLOCATION STRUCTURES IN DEFORMED SINGLE CRYSTALS AND WORK-HARDENING THEORIES. Hirsch, P. B. (Oxford Univ.); Mitchell, T. E. Met. Soc. Conf., 46: 65-95(1968).

From Symposium on Work Hardening, Chicago, Ill. See CONF-661142.

A review is presented of the dislocation distributions in deformed single crystals of fcc, bcc, and hcp metals, in the various stages of the work-hardening curves. Relevant work-hardening theories are discussed critically. (auth)

34005 CRYSTALLOGRAPHY OF TITANIUM ALLOY MARTENSITES. Hammond, C.; Kelly, P. M. (Univ. of Leeds, Eng.). Acta Met., 17: 869-82(July 1969).

Two α (hexagonal) martensites occur in a titanium–5% manganese alloy. These are characterized by a $\{344\}_\beta$ and a $\{344\}_\beta$ habit plane. Electron microscopy reveals that the latter consists of a stack of fine $\{1011\}_\alpha$ twins and that the habit plane is zig-zagged across the twin boundaries. The experimental results are consistent with the Bowles–Mackenzie theory of martensite transformations and the particular $\{344\}_\beta$ habit plane variants correspond to both Class A ($\alpha - \omega +$) and A ($\alpha + \omega +$) solutions. The occurrence of two types of martensite is shown to be dependent upon the ratio of the α and β lattice parameters at the transformation temperature; the $\{344\}_\beta$ martensite being favored with increasing β stabilizing solute content. The zig-zag interfaces are explained on the basis of small scale dilatations which occur in order to minimize the strain at each twin–β matrix interface. An fcc martensite occurs twinned on one or two sets of $\{111\}_f$ planes, and the experimental results are explained on the assumption that these correspond to the inhomogeneous shear of the transformation process. The possibility that this martensite is a result of a spontaneous transformation in thin foils is discussed. (auth)

34006 THE ω PHASE IN A Zr–25 AT. PERCENT Ti ALLOY. Sass, S. L. (Technological Univ., Delft, Netherlands). Acta Met., 17: 813-20(July 1969).

Dark field electron microscopy showed that the as-quenched ω phase was distributed as equiaxed particles ~10 Å in diameter in rows along $\langle 111\rangle_\beta \parallel \langle 0001\rangle_\omega$ with a minimum interparticle spacing of 15 Å. These observations as well as the analysis of selected area diffraction patterns confirmed that there were four orientations of the as-quenched ω phase. Diffraction studies showed the presence in reciprocal space of $\{111\}$ planes of diffuse intensity, which were related to the $\langle 111\rangle$ row morphology. The $10\bar{1}0_\omega$ and $20\bar{2}0_\omega$ reflections were shown to result from double diffraction in as-quenched alloys and to be real in aged alloys. A transformation mechanism was suggested in which the bcc structure becomes metastable relative to $\langle 111\rangle$ longitudinal displacement waves which initiate the bcc → ω transition. (auth)

34007 YTTRIUM–BISMUTH ALLOY SYSTEM. Schmidt, F. A.; McMasters, O. D.; Lichtenberg, R. R. (Ames Lab., Iowa). J. Less-Common Metals, 18: 215-20(July 1969).

The yttrium–bismuth alloy system was studied using microscopic, x-ray, thermal, and chemical analyses. An inverted peritectic reaction develops as a result of bismuth additions lowering the 1475°C transformation temperature of yttrium to 1466°C. Eutectic reactions occur at 18.5 at. % Bi and 1145°C, and greater than 99.9 at. % Bi and 269°C. There are only two intermetallic compounds in the system. The compound YBi melts congruently at 2020°C and X_5Bi_3 results from a peritectic reaction at 1530°C. The crystal structure of this second compound is discussed. (auth)

34008 YTTERBIUM–GOLD SYSTEM. Iandelli, A.; Palenzona, A. (Univ., Genoa). J. Less-Common Metals, 18: 221-7 (July 1969).

The ytterbium–gold system was investigated using differential thermal, micrographic, and x-ray methods. In the phase diagram, eight intermediate phases appear at the compositions: Yb_7Au_3, Yb_2Au, Yb_5Au_3, Yb_5Au_4, YbAu, $YbAu_2$, $YbAu_3$, and $YbAu_4$. Of these, three compounds have congruent melting points (YbAu: m.p. 1292°C; $YbAu_3$: 1240°C; $YbAu_3$: 1150°C); the others are formed by peritectic reactions (Yb_7Au_3: peritectic point 661°C; Yb_2Au: 712°C; Yb_5Au_3: 861°C; Yb_5Au_4: 926°C; $YbAu_4$: 989°C). Four eutectic points exist at 18.5 at. % Au (546°C); 58.5 at. % Au (1061°C); 72.0 at. % Au (1131°C); 89.0 at. % Au (809°C). The compositions of the phases were confirmed by determining the corresponding crystal structures. Solid-solubility exists for gold in YbAu and for ytterbium in gold. From magnetic measurements, ytterbium is found to be trivalent in the three compounds richest in gold and is divalent in the others. (auth)

34009 CRYSTALLINE STRUCTURES OF ERBIUM–COBALT INTERMETALLIC COMPOUNDS OF COMPOSITIONS INTERMEDIATE BETWEEN $ErCo_5$ AND Er_2Co_{17}. Schweizer, J.; Tasset, F. (CEN-G, Grenoble, France). J. Less-Common Metals, 18: 245-50(July 1969). (In French).

The intermetallic compounds $ErCo_x$ were investigated by x-ray diffraction method in the composition range between Er_2Co_7 (x = 3.5) and Er_2Co_{17} (x = 8.5). For the quenched samples with $5.5 < x < 5.75$ the crystal structure is found to be of the $CaZn_5$ type, part of the Er sites of the ideal structure being occupied at random by a pair of Co atoms. For $x > 5.75$ two phases are observed; the $CaZn_5$-type phase coexists with another structure having an ordered arrangement of the Co pairs at the Er sites. At x = 8.5 the latter gives the Er_2Co_{17} structure. In the annealed samples a mixture of the Er_2Co_7 and Er_2Co_{17} phases can be observed. The variation of the lattice parameters with the concentration has also been studied. (auth)

34010 STUDY OF THE ELECTRONIC STRUCTURE AND INTERATOMIC BONDS IN SOME COMPOUNDS AND BINARY ALLOYS BY THE METHOD OF X-RAY SPECTROSCOPY. Nemnonov, S. A.; Menshikov, A. Z.; Kolobova, K. M.; Kurmaev, E. Z.; Trapeznikov, V. A. (Inst. of Metal Physics, Sverdlovsk, USSR). Trans. Met. Soc. AIME, 245: 1191-8(June 1969).

A review of investigations into the x-ray spectra of solids is presented. Lines of approach such as study of the electronic structure of high-melting compounds of transition metals and study of the interatomic binding forces by the fine structure of absorption spectra under varying temperature and concentration conditions were used. With this in mind, investigations have been made into the emission and absorption spectra of the K-series of atoms of transition elements in alloys and compounds. (auth)

34011 NEW A_3B_5 PHASES OF THE TITANIUM GROUP METALS WITH RHODIUM. Giessen, B. C.; Wang, R.; Grant, N. J. (Massachusetts Inst. of Tech., Cambridge). Trans. Met. Soc. AIME, 245: 1207-10(June 1969).

By crystallographic and x-ray methods, the existence and isomorphism of Ti_3Rh_5 and Hf_3Rh_5 were confirmed. Both phases are of the orthorhombic Ge_3Rh_5 type; lattice parameters and refined positional parameters are given. The structure is related

both to the filled-up NiAs-B8 and Cu-A1 types. An analogous phase with zirconium does not exist; the effect of ternary substitutions for titanium and hafnium suggests a size factor limit to be active. (auth)

34012 OMEGA PHASE PRECIPITATION IN ALLOYS OF TITANIUM WITH TRANSITION METALS. Hickman, B. S. (North American Rockwell Corp., Thousand Oaks, Calif.). Trans. Met. Soc. AIME, 245: 1329-36(June 1969).

Using primarily quantitative single crystal x-ray techniques, studies have been made of the precipitation of the metastable ω phase in alloys of titanium with Mo, Mn, Fe, Cr, and Nb. It is shown that, in agreement with earlier work on the Ti–V system, the composition of the ω phase during aging approaches a constant; the value varies from one system to another in a systematic manner with the electron concentration. Results relevant to the mechanism of ω precipitation during quenching and during aging are presented and discussed. Results are presented to confirm that the ω phase is coherent and the morphology of the precipitates is described and discussed. (auth)

34013 EFFECTS OF SOLUTE ADDITIONS ON THE STACKING FAULT ENERGY OF A NICKEL-BASE SUPERALLOY. Kotval, P. S.; Nestor, O. H. (Union Carbide Corp., Indianapolis). Trans. Met. Soc. AIME, 245: 1275-8(June 1969).

Stacking fault energy measurements of nickel-base alloys have been mainly confined to binary and ternary systems. The stacking fault energy has been measured by the rolling texture method in a series of ten alloys which comprise successive additions of Cr, Mo, Fe, and C to pure nickel, eventually resulting in an alloy of the composition of Hastelloy X. The alloys studied here are single-phase, solid solutions with the exception of two alloys in which some undissolved particles of primary carbide have been retained. It is found that successive additions of chromium, molybdenum, and iron all lower the stacking fault energy, with iron having only a minor effect. The stacking fault energy is found to increase when carbon is added in solid solution. The results from the rolling texture measurements are correlated with thin foil observations of dislocation substructures in these alloys. (auth)

34014 A STUDY OF THE SCANDIUM–MAGNESIUM SYSTEM FROM 0 TO 60 AT. PERCENT SCANDIUM. Beaudry, B. J.; Daane, A. H. (Ames Lab., Iowa). J. Less-Common Metals, 18: 305-8(July 1969).

The magnesium–scandium system was studied from 0 to 60 at. % Sc by thermal, metallographic, and x-ray methods. A tentative phase diagram of the Mg–Sc system from 0 to 60 at. % Sc is given. The solubility of Sc in Mg was 21 at. % at 480°C. (G.M.C.)

34015 STRUCTURE AND HARDENING OF AN AUSTENITIC ALLOY, Fe–30 PERCENT Ni–5 PERCENT Nb. Manenc, J.; Bourgeot, J.; deBoer, H. Scr. Met., 2: 453-7(Aug. 1968). (In French).

Austenitic 30% Ni–5% Nb alloys containing 0.017% C were vacuum melted and cast, homogenized at 1200°C., then studied by Vickers hardness measurements, x-ray diffraction, and optical microscopy. Results show that the alloy is austenitic when water quenched from 1200°C, but that martensite transformation occurs at –100°C on cooling to liquid N_2 temperature. The martensite has a quadratic structure. Lattice parameters for austenite and martensite are given. Hardness curves are given for homogenized specimens subjected to isothermal aging. The hardness after aging at 700 and 800°C is only slightly higher than that obtained by aging at 550 to 600°C. Hardening above 700°C results from precipitation of an equilibrium Fe_7Nb_3 phase. (Metals Abstr.)

34016 THE FORMATION OF OMEGA PHASE IN TITANIUM AND ZIRCONIUM ALLOYS: A REVIEW. Hickman, B. S. (North American Rockwell Corp., Thousand Oaks, Calif.). J. Mater. Sci., 4: 554-63(June 1969).

The omega phase is a metastable phase which forms in alloys of titanium and zirconium with most transition metals. The available data from both alloy systems on the occurrence, the structure, the mechanism of formation, and the morphology of the phase are reviewed and compared. The effect of omega phase on the mechanical behavior and on the superconducting properties is discussed. Uncertainties still exist on the mechanism of the omega transformation during quenching and on the mechanism of the effect of omega on the mechanical properties. (auth) (UK)

34017 CRYSTAL STRUCTURE OF W_2FeB_2 (HIGH-TEMPERATURE FORM). Jedlicka, H.; Nowotny, H.; Benesovsky, F. Monatsh. Chem., 99: 1068-9(1968). (In German).

The ordinary U_2Si_2-type structure (trigonal prismatic) exists in alloys containing W 20 to 25, Fe 30, and B 45–60 at. % produced in an electric-arc melt from a reaction mixture homogenized at 1000°C a second W_2CoB_2 type occurs. Crystal data for the high-temperature form are presented. (Metals Abstr.)

34018 LATTICE VIBRATIONS OF GALLIUM METAL. II. EXPERIMENTAL DETERMINATION OF THE PHONON DISPERSION RELATION. Waeber, W. B. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., C (London), 2: 903-13 (May 1969).

The method of neutron inelastic scattering was used to determine the phonon dispersion relation (12 branches) of gallium at 77°K in the three main symmetry directions [ξ00], [0ξ0] and [00ξ]. To achieve this the so-called phonon structure factor was calculated, indicating as a function of position in reciprocal space the total intensity of the phonon peaks belonging to any particular irreducible representation. (auth) (UK)

34019 THE τ-PHASE IN THE TERNARY SYSTEM NICKEL–MANGANESE–BORON. Stadelmaier, H. H.; Miller, B. E. (North Carolina State Univ., Raleigh). Metall, 23: 11-13(Jan. 1969). (In German).

In the Ni–Mn–B system, a congruently melting ternary phase (τ) with a cubic structure of the $Cr_{23}C_6$ structure type was observed. At 800°C a change from $Ni_{21}Mn_2B_6$ to $Ni_{15}Mn_8B_6$ took place. A second ternary phase with unknown structure was found at about $Ni_{46}Mn_{36}B_{18}$. (M.C.G.)

34020 CORRELATION BETWEEN MICROSTRUCTURE AND STRESS RUPTURE PROPERTIES OF A Co–Cr–Ni–W (HS-25) ALLOY. Yukawa, N. (Nagoya Univ., Japan); Sato, K. Trans. Jap. Inst. Metals, 9: Suppl., 680-6(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

The effect of high-temperature aging on the microstructure and the precipitation kinetics of a HS-25 (L-605) alloy was studied by means of optical and electron microscopy as well as by x-ray and electron diffraction techniques. The precipitation behaviors were examined with specimens subjected to aging, stress rupture and creep conditions, through which the correlation between the precipitation phenomena and the mechanical properties was delineated. The following seven kinds of phases precipitate in the alloy during aging; M_7C_3, $M_{23}C_6$, M_6C, α-Co_3W, β-Co_3W, Laves-Co_2W and μ-Co_7W_6. The processes of precipitation at about 800 and 700°C are proposed, respectively, as follows: $(M_7C_3) \rightarrow M_{23}C_6 \rightarrow M_6C \rightarrow$ Laves-$Co_2W \rightarrow \mu$-Co_7W_6, at about 800°C, while $(M_7C_3) \rightarrow M_{23}C_6 \rightarrow M_6C \rightarrow (\alpha$-$Co_3W) \rightarrow \beta$-$Co_3W \rightarrow$ Laves-Co_2W, at about 700°C, where the phases parenthesized are considered to be metastable. In these processes, the precipitation of α-Co_3W (ordered fcc), which is coherent to the matrix and transforms to β-Co_3W (ordered hex.) after aging for a long time, plays an important role in strengthening the alloy at temperatures below 700°C. On the other hand, age-hardening at temperatures above 800°C is attributed mainly to the precipitation of carbides ($M_{23}C_6$ and M_6C) and Laves-Co_2W. The alloy is also considerably hardened by cold working, which introduces stacking faults (S.F.s) and the hcp-phase within the matrix. Furthermore, on aging the cold-worked specimen at lower temperatures, the carbides and α- and β-Co_3W precipitate preferentially on either S.F.s or hcp-phase, causing a more marked subsequent age-hardening; at higher temperatures, however, the disappearance of S.F.s and the recrystallization of the matrix result in the softening of the alloy. (auth)

Radiation Effects

Refer also to abstract 33979.

34021 (AD-684067) USA STUDIES ON IRRADIATION EFFECTS TO ADVANCED PRESSURE VESSEL MATERIALS. Interim Report, 1967–1968. Steele, Lendell E. (Naval Research Lab., Washington, D. C.). Dec. 1, 1968. 51p. (NRL-MR-1947). CFSTI.

Research discussed includes the preirradiation examination of high strength candidate pressure vessel materials, studies of irradiation effects on the properties of advanced pressure vessel materials, and fatigue and hydrogen embrittlement effects in irradiated higher strength steels. High points of experimental accomplishment are outlined in brief. (auth) (USGRDR)

34022 (AD-685591) IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS. Quarterly Progress Report, November 1, 1968–January 31, 1969. Steele, L. E.; Hawthorne, J. R.; Serpan, C. Z. Jr.; Potapovs, Uldis; Watson, H. E. (Naval Research Lab., Washington, D. C.). Feb. 15, 1969. 31p. (NRL-MR-1962). CFSTI.

The following are described: development of dynamic tear test facility, properties of steels irradiated in the Big Rock Point Reactor, fracture evaluation of irradiated A302-B and A543 steel plate and weld metals, response of A350-LF1 (Mod.) steel to cyclic irradiation and annealing treatments, and frac-

tographic examination of variable irradiation sensitivity steels. (auth) (USGRDR)

34023 (AECL-3086(Rev.)) EFFECT OF THE FAST NEUTRON SPECTRUM ON THE RATE AND DISTRIBUTION OF DAMAGE IN ZIRCONIUM. Piercy, G. R. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Apr. 1968; Revised Feb. 1969. 33p. Dep. CFSTI. CAN $1.00.

The damage rate produced by neutron irradiation of zirconium is calculated in terms of the energy given to the lattice. The effects of anisotropic elastic neutron scattering, inelastic neutron scattering, and energy loss to electron excitation using Lindhard's theory, are included. The results are applied to correlate the damage rate in seven different reactor spectra in terms of the associated ^{58}Ni monitor activity. The number of damage regions as a function of their lattice energy is also estimated and applied to several experiments. (auth)

34024 (GEAP-5746) ZIRCALOY-CLAD UO_2 FUEL ROD EVALUATION PROGRAM. Quarterly Progress Report No. 5, November 1968-January 1969. Megerth, F. H. (comp.) (General Electric Co., San Jose, Calif. Nuclear Fuels Dept.). Feb. 1969. Contract AT(04-3)-189. 21p. Dep. CFSTI.

The gas contents of seven cladding samples from five irradiated fuel rods were determined by vacuum hot extraction followed by chromatographic analysis with the molecular sieve column. The volumes of gases collected ranged from 600 to 1100 microliters per gram of cladding and contained from 87 to 90 percent hydrogen and from 9 to 12 percent carbon monoxide. Approximately 1 percent nitrogen was detected in three samples, and traces of methane were detected in six samples. In terms of parts per million, the hydrogen contents ranged from 50 to 89 ppM. The maximum absorption of corrosion-generated hydrogen was about 4 percent. The UO_2 of a transverse section through one of the fuel rods was examined by replica electron microscopy. The average burnup over the cross section was 8.1×10^{20} fissions/cc (29,700 MWd/tU). There was no evidence of central grain growth. The interior of the grains in the central region of the fuel contained many small precipitates. Their concentration increased between the center and mid-radial location, then decreased sharply, and remained relatively low to a location about 0.01 cm from the pellet periphery. Between the latter location and the periphery, the concentration underwent a sharp increase. The intragranular precipitates adjacent to the cladding were somewhat larger than those near the center. The grain boundaries near the periphery of the UO_2 were more heavily etched than the centrally located grain boundaries. The severity of the grain boundary etching effect varied with fuel radius in a manner which can be correlated to the radial distribution of burnup. The radial dependence of burnup, uranium and plutonium isotopic contents, and the abundances of ^{241}Am, ^{242}Am, ^{244}Cm, ^{148}Nd, ^{137}Cs, ^{106}Ru, ^{134}Cs, and ^{144}Ce was determined from analyses of fuel samples taken at different radial locations from the maximum burnup location of a high exposure fuel rod. These data are presented. (auth)

34025 (GEMP-692) VOIDS IN IRRADIATED TUNGSTEN AND MOLYBDENUM. Rau, R. C.; Ladd, R. L.; Moteff, J. (General Electric Co., Cincinnati, Ohio. Missile and Space Div.). [1969]. Contract AT(40-1)-2847. 9p. Dep. CFSTI.

Three-dimensional cavities, or voids, were generated when body-centered cubic tungsten and molybdenum specimens were irradiated to fast neutron fluences of 1.3 to 1.8×10^{20} n/cm^2. These vacancy-filled voids were observed only when the irradiation temperatures were at or above 0.31 T_m (T_m is the absolute melting point) for the metal. The void size and volume fraction in both tungsten and molybdenum increased with increasing irradiation temperature. At comparable homologous irradiation temperatures tungsten contained smaller voids and a lower percentage of void volume than molybdenum. These relatively stable voids act as barriers to dislocation motion and thus could affect the high temperature strength properties of a material. (G.M.C.)

34026 (KFK-932) RADIATION EFFECTS IN ORDERED Fe-Al ALLOYS: MOESSBAUER EXPERIMENTS FOLLOWING NEUTRON CAPTURE. Berger, Wolfram G.; Czjzek, Gordon (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Feb. 1969. 10p. (CONF-680910-9). Dep.

From International Conference on Vacancies and Interstitials in Metals, Juelich, Germany.

Moessbauer effect with ^{57}Fe following neutron capture in ^{56}Fe has been investigated in Fe-Al alloys in the concentration range from about 26 to 52 at. % Al. In ordered alloys of CsCl structure we observed line shifts due to recoil effects following neutron capture. In a Fe_3Al alloy of DO_3 type order additional changes in the internal magnetic fields have been found. Both effects are discussed in terms of possible final positions for the primary recoiled iron atom in the lattice. (auth)

34027 (ORNL-TM-2506) POSTIRRADIATION NONDESTRUCTIVE EXAMINATION OF A SILVER-CADMIUM-INDIUM CONTROL ROD FROM THE ARMY SM-1 POWER REACTOR. Richt, A. E.; Haynes, V. O. (Oak Ridge National Lab., Tenn.). June 1969. Contract W-7405-eng-26. 21p. Dep. CFSTI.

An experimental silver-cadmium-indium neutron absorber element has been examined nondestructively after 10.4 Mwyr of service in the Army SM-1 Stationary Medium Power Reactor. The purpose of this examination was to determine if the element was dimensionally and structurally suitable for continued testing in the reactor; ultimately, it is hoped to establish the useful lifetime of this type of absorber element in the SM-1. The element was apparently in excellent physical condition. No evidence of structural damage was noted visually, gamma scans showed no indications of abnormalities in the absorber burnup distribution, and the outer dimensions of the element were well within acceptable limits. The sides of the absorber box were slightly thicker than the nominal 0.156-in. value; however, this appears to be typical of the absorber fabrication procedures and not a result of irradiation-induced swelling. Since the element appeared to be in excellent physical condition, it was returned to the SM-1 for continuation of the irradiation testing program. (auth)

34028 (UCRL-50621) THERMO-DYNAMIC EFFECTS INDUCED IN METALS BY A 2-MeV PULSED ELECTRON BEAM. Woodruff, L. W. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 8, 1969. 161p. Dep. CFSTI.

Thesis.

The absorption of a burst of high energy electrons in metals and the effects were investigated. A pulsed electron beam system was used which emitted electrons with energies up to 2 MeV in a time period of about 50 nsec. Heating the metal targets to a depth of 1 g/cm^2 and energy fluxes up to 25 cal/cm^2 resulted. The energy profile of the electron beam was mapped radially and axially using aluminum calorimeters, and its energy spectrum was determined. Energy deposition profiles were semiempirically predicted and were corroborated by measurements made with calorimeters. Surface response of irradiated lead and gold targets was made. Peak energy deposition was found to be about 50 cal/g, producing pressures of the order of 50 kb (kilobars). Relief of this high pressure resulted in spallation of surface material from the target, producing a corresponding impulse in the remaining target material. The initial surface velocities of the spalled materials were determined from photographs; peak values obtained for lead and gold were 40,000 and 25,000 cm/sec, respectively. Mass loss measurements indicated that spall occurred at the depth below the target surface where sufficient energy was deposited to initiate melting at atmospheric pressure. The predicted results for target impulse and for surface velocity of the spalled material were lower than those determined experimentally, indicating that the calculated values of pressure were too low and the material followed an essentially equilibrium process while changing phase. The equation of state for lead was revised to include an estimate of the appropriate thermodynamic behavior in the two-phase region. Calculations of impulse and surface velocity including this modification yielded values less than 15% above the experimental results for an exposure of 20 cal/cm^2. (auth)

34029 WORK-HARDENING BEHAVIOR OF IRRADIATED ALUMINUM. Ono, Kanji (Univ. of California, Los Angeles); Meshii, M. Met. Soc. Conf., 46: 227-46(1968).

From Symposium on Work Hardening, Chicago, Ill. See CONF-661142.

Effects of 1.0 MeV electron irradiation on work-hardening behavior of aluminum single crystals (99.999%) were studied at 23°K. When a crystal was irradiated with little or no prior deformation, the work hardening rate in the easy glide, θ_I, was unaffected, whereas the extent of the easy glide was increased significantly. When a crystal was deformed to the linear hardening region prior to irradiation, a decrease in the work hardening rate was observed. With increasing irradiation dosage, the work-hardening rate approached that observed in the easy glide region, θ_I, at a dosage of 1.4×10^{17} e/cm^2. The irradiation increased the flow stress in both cases. The prior deformation suppressed the hardening effect due to the irradiation. The magnitude of this suppression was about 20% of the flow stress before irradiation. The observed behavior can be interpreted as follows: the hardening effects due to irradiation at 23°K are caused by dispersed interstitials via the dispersed barrier mechanism, work-hardening in the easy glide is caused by the activity of the primary slip system alone, a high rate of work-hardening in the linear hardening region is observed only when the secondary slip systems are active. In the light of the present observations, various theories

of work-hardening, both in the easy glide and linear hardening regions, are examined. (auth)

34030 PRE-PRECIPITATION RATE IN AN ALUMINIUM–10 PERCENT ZINC ALLOY IRRADIATED AT 78°K. Schuele, W. (CCR–EURATOM, Ispra, Italy). Phil. Mag., 19: 1085-8(May 1969).

In Al–10% Zn alloy interstitials probably do not migrate and annihilate below 150°K. Arguments are given suggesting that the onset of the formation of Guinier–Preston zones above 150°K occurs by an interstitial diffusion mechanism. (auth) (UK)

34031 AGEING CHARACTERISTICS OF NEUTRON-IRRADIATED COPPER–9.5 AT. PERCENT BERYLLIUM ALLOY. Yoshida, Hiroyuki (Kyoto Univ., Osaka). Phil. Mag., 19: 987-92(May 1969).

The post-irradiation ageing characteristics of a copper–9.5 at. % beryllium alloy containing 0.2 at. % zinc were investigated by the measurement of electrical resistivity. The amount of increase in resistivity by irradiation decreased with decreasing degree of supersaturation of beryllium in the matrix of specimens. The isothermal ageing curves of the resistivity for the irradiated specimens at 250°C showed two stages, an initial small and a following large decrease. The first stage is interpreted as due to the dissolution of Guinier–Preston zones formed during irradiation, and the early period of the second stage as due to the precipitation of intermediate γ' phase. It was found that the time needed for the initiation of the precipitation of γ' phase is much shorter for the irradiated specimens than for the unirradiated specimens. (auth) (UK)

34032 INTERSTITIAL CLUSTERS OBSERVED BELOW STAGE III ANNEALING IN ELECTRON IRRADIATED PURE GOLD. Shimomura, Y. (Univ. of Illinois, Urbana). Contract AT(11-1)-1198. Phil. Mag., 19: 773-94(Apr. 1969).

Pure gold specimens were irradiated at 130°K with 3 MeV electrons. The total flux was from 1.2 to 6.0×10^{18} e/cm^2. At temperatures below stage III annealing a large number of interstitial loops were observed in irradiated specimens by electron microscopy. The number of loops decreased with increasing purity and was independent of the electron flux. The number was 8×10^{14} cm^{-3} for 99.9999% purity and 2×10^{16} cm^{-3} for 99.999% purity. Their size was larger in purer specimens and increased with increasing total flux. Typical average sizes of defects in 99.9999% pure specimens were 46 Å (260 interstitials per cluster) and 72 Å (660 interstitials per cluster) for 1.2×10^{18} and 6.0×10^{18} e/cm^2, respectively. These clusters, even the smallest observable clusters of 10 Å in size, were quite stable and never broke up near room temperature. They shrank and disappeared completely, however, in bulk specimens during stage III annealing. Evidence was found showing the importance of the strain field of interstitial loops for the vacancy annihilation during stage III annealing. The experimental results can be explained by supposing that lattice vacancies migrate in stage III. (auth) (UK)

34033 A PHENOMENON OF INTERACTION BETWEEN RADIATION DEFECTS AND DISLOCATIONS IN POLYCRYSTALLINE SILVER. Fornerod, R.-C. (Univ., Lausanne, Switzerland). Mem. Sci. Rev. Met., 66: 157-66(Feb. 1969). (In French).

Dislocations by neutron irradiation in silver at room temperature were studied by internal friction and module defect measurements. A comparison with the results of copper and gold experiments is included. (tr-auth)

34034 DEPTH DISTRIBUTIONS OF VACANCY CLUSTERS IN ION BOMBARDED GOLD AND NICKEL. Norris, D. I. R. (Central Electricity Generating Board, Berkeley, Eng.). Phil. Mag., 19: 653-62(Apr. 1969).

Stereo electron microscopy was used to obtain depth distributions of vacancy clusters in gold and nickel bombarded with 80–150 keV mercury or gold ions at 295 and at 80°K. Clusters were found at depths comparable to the ranges of non-channelled ions. The ratio of median cluster depth to Lindhard projected range was 1.0 in gold and 0.5 in nickel. No temperature effect was found. The cluster size distribution did not vary significantly with depth. (auth) (UK)

34035 BETA EMBRITTLEMENT OF THE Zr–2.5 WT PERCENT Nb(Cb) ALLOY. Ells, C. E.; Williams, C. D. (Chalk River Nuclear Labs., Ont.). Trans. Met. Soc. AIME, 245: 1321-8(June 1969).

The susceptibility of quenched and aged Zr–2.5 wt % Nb alloy to embrittlement during irradiation has been examined for a number of solution temperatures and aging times. Material quenched from temperatures approximately 40°C below the β transus has high tensile ductility, and this ductility is insensitive to aging at 500°C or to irradiation. If, however, the material is quenched from temperatures above the transus it becomes highly susceptible to loss of ductility either from aging at 500°C or from irradiation. Intergranular failure is characteristic of the materials having low ductility. The distribution of the equilibrium α phase is found to control the susceptibility to embrittlement by restricting β grain growth during heat treatment and thus influencing crack propagation. (auth)

34036 CALCULATION OF RELATIVE DISPLACEMENT DAMAGE RATES IN DIFFERING REACTOR TYPES. Birss, I. R. (United Kingdom Atomic Energy Authority, Sellafield, Eng.). J. Nucl. Energy, 23: 239-49(Apr. 1969).

The assessment of the results of accelerated tests of thermal reactor materials, irradiated in fast reactors, is examined. It is shown that, if it can be accepted that the ratio of atomic displacement rate in the test reactor to displacement rate in the parent reactor is an acceptable parameter for comparison purposes, then the atomic displacement energy and the electronic cut-off energy of a material are not critical parameters in the derivation of this ratio. It is also shown that, if the equivalent fission flux concept is used to describe reactor spectra, it can lead to appreciable errors in deriving the damage ratio, but that integration over the real spectrum is unnecessary below about 0.1 MeV. (UK)

34037 FUNDAMENTAL PROPERTIES OF MATERIALS IN NUCLEAR FUEL ASSEMBLIES. Proceedings of the ANS Topical Meeting, Held at Schenectady, New York, August 22–23, 1968. Robertson, J. A. L.; Carter, R. E.; Lay, K. W.; Lee, D. (eds.). J. Nucl. Mater., 30: 1-248(Apr. 1969). (In French and English). (CONF-680825).

A total of 23 papers was presented at the meeting. A separate abstract was prepared for each paper. (G.M.C.)

For abstracts of individual papers see: 33931, 33969, 34038–34043, 34093–34102, 34116, 34117, and 34123–34125.

34038 FRACTURE OF IRRADIATED ZIRCALOY-2. Hoagland, R. G. (Battelle-Northwest, Richland, Wash.); Rowe, R. G. J. Nucl. Mater., 30: 179-95(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

The fracture behavior of Zircaloy-2 as influenced by BWR and PWR conditions is summarized. The response of the fracture toughness of Zircaloy-2 to various combinations of cold work, hydrogen content and neutron fluence in hot pressurized water is characterized by embrittlement to a point where saturation in the fracture toughness is attained. Further in-reactor exposure beyond this saturation point appears to have no effect on toughness although other mechanical properties such as flow stress continue to change. In addition, anisotropy in the toughness of rolled plate material, evident in the unirradiated condition, is retained during in-reactor exposure and after increases in hydrogen content. Several processes are thought to be contributing to the toughness of Zircaloy-2 during irradiation. The reduction in toughness at low exposures must result from defect interactions with the deformation modes and the formation of the brittle hydride phase. However, the occurrence of saturation is not explained by these mechanisms in view of data on other mechanical properties and corrosion rates. It is suggested that the difference in the conditions for initiation of slip and twinning would indicate that the twinning component of deformation is not reduced by irradiation damage as much as the slip component. Saturation is, therefore, interpretable on the basis that twinning plays a major role in the crack tip plastic zone after irradiation. Additional study of the importance of twinning in determining the toughness of Zircaloy-2 was attempted by examining the relationship between texture and the anisotropy in fracture toughness. A correlation is shown to exist between the crack tip shear stresses resolved on the $\{11\bar{2}1\}\langle 11\bar{2}6\rangle$ twin system and the toughness anisotropy. (auth)

34039 UNIRRADIATED, IN-PILE, AND POST-IRRADIATION LOW STRAIN RATE TENSILE PROPERTIES OF ZIRCALOY-4. Azzarto, F. J.; Baldwin, E. E.; Wiesinger, F. W.; Lewis, D. M. (Knolls Atomic Power Lab., Schenectady, N. Y.). J. Nucl. Mater., 30: 208-18(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

Zircaloy, used both as a structural material and as a fuel and poison element cladding in water-cooled reactor cores, is subject to a strain-controlled deformation, with strains in many instances, going into the plastic range. Equipment was designed and constructed for in-reactor tensile tests in a 282°C water loop at strain rates ranging from 5×10^{-6} to 10^{-3}/hr. Tensile tests of material in the unirradiated and post-irradiated conditions were made at 282 and 315°C and strain rates from 3×10^{0} to 5×10^{-6}/hr. Specimens were of longitudinal and transverse orientation to the rolling direction of a Zircaloy-4 plate. A total of seven in-reactor tests at 282°C were conducted; two longitudinal specimens at strain

rates of 10^{-5} and 5×10^{-6}/hr and five transverse specimens at strain rates from 1×10^{-4} to 5×10^{-6}/hr. Most specimens were tested to between 1 and 3 percent total strain. The results of the in-reactor tests indicate that in a neutron environment in the range of strain rates investigated, Zircaloy-4 has an apparent strain rate sensitivity index, $m = 0.23$, compared to unirradiated and post-irradiated Zircaloy-4 with $m \approx 0.03$. As with unirradiated Zircaloy-4, the in-reactor 0.2% yield strength in the transverse direction was higher than in the longitudinal direction. The in-reactor 0.2% yield strength at 5×10^{-6}/hr was significantly lower than for a comparable post-irradiated test. (auth)

34040 NON-LINEAR GROWTH IN ZIRCALOY-4. Hesketh, R. V. (Central Electricity Generating Board, Berkeley, Eng.). J. Nucl. Mater., 30: 219-21(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

In Zircaloy-4, at strains less than 0.001, irradiation growth is accurately proportional to the square root of the fast neutron fluence and saturation may occur at high doses. To explain this behavior, a model is proposed which assumes the existence of a constant number of interstitial loops of appreciable size and growth of the loops by long range diffusion of mobile defects. (G.M.C.)

34041 INFLUENCE OF DEFORMATION AND RUPTURE CHARACTERISTICS ON THE BRITTLENESS AT HIGH TEMPERATURE AFTER IRRADIATION OF SEVERAL METALS AND ALLOYS WITH FACE-CENTERED CUBIC STRUCTURE. Sainfort, G.; Gregoire, J.; Morgand, P.; Silvent, A.; Cabane, G. (CEN, Grenoble, France). J. Nucl. Mater., 30: 222-33(Apr. 1969). (In French).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

The hot brittleness, after irradiation, of several face-centered cubic metals and alloys is studied; some stainless steels, a precipitation-hardening nickel alloy, pure nickel and pure copper, copper hardened by silica particles are examined. The hypothesis based on the notion of embrittlement connected with the presence of helium in cavities or cracks resulting from hot deformation can account for the principal results obtained, namely: Multiplication of cavities; gradual blockage of grain boundary migration; reduction of the critical size for growth of a crack; increase of the rate of growth of a major crack initiated at triple junctions. (auth)

34042 A PHENOMENOLOGICAL THEORY OF THE IRRADIATION EMBRITTLEMENT OF IRON AND STEEL. Igata, N.; Hasiguti, R. R. (Tokyo Univ.). J. Nucl. Mater., 30: 234-41(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

The shift of the ductile-brittle transition temperature with neutron irradiation is structure sensitive. The effect of microstructure on the transition temperature of iron and steel, before and after irradiation, is analyzed and discussed. At first, yield stress (σ_y) and fracture stress (σ_f) are given by the Petch relation, and it is assumed that the effect of interstitial or substitutional solute atoms, dislocations and precipitates are included in the term that is independent of grain size. Secondly, the ductile-brittle transition is given by the temperature at which $\sigma_y = \sigma_f$. From the assumptions the effects of structural factors on the ductile-brittle transition temperature, before and after irradiation, are obtained. Before irradiation, the finer the grain size, the higher the transition temperature. The higher the concentration of interstitial atoms, the higher the transition temperature. However, this may not always be so for substitutional alloying elements. If precipitates are closely spaced, the transition temperature is decreased. An increase of dislocation density results in an increase in the transition temperature. With respect to irradiation sensitivity, the analysis shows that the grain size, substitutional or interstitial atoms, precipitates and dislocation densities affect the transition temperature depending on the change of the coefficients for each of the factors with irradiation. The effect of the structural factors on the transition temperature after irradiation was also analyzed. The conclusions from this analysis are compared with experimental results. (auth)

34043 INFLUENCE OF NEUTRON IRRADIATION ON TENSILE AND STRESS RUPTURE PROPERTIES OF INCONEL 625. Garzarolli, F.; Francke, K. P.; Fischer, J. (Allgemeine Elektricitaets-Gesellschaft, Grosswelzheim, Ger.). J. Nucl. Mater., 30: 242-6(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

Investigations revealed that irradiation near 650°C causes in Inconel 625, an alloy hardening by metastable precipitates and a drastic decrease of creep strength of 30%, in addition to the normally observed high temperature embrittlement. This decrease of creep strength may be due to neutron-enhanced overaging. (auth)

34044 IRRADIATION PROPERTIES OF MAGNETIC MATERIALS. Stephen, J. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Energy, 76-82(May-June 1969).

The application of a magnetic material in the instrumentation and control of nuclear reactors depends upon an accurate knowledge of its behavior under nuclear irradiation and at elevated temperature. A range of magnetic materials including ferrites is discussed, and their suitability for "in-pile" applications assessed. The method used at Harwell for the continuous in-pile measurement of magnetic properties is described, together with examples of the applications of magnetic materials to reactor problems. (auth) (UK)

34045 INFLUENCE OF THERMO-MECHANICAL TREATMENT ON HIGH-TEMPERATURE, EMBRITTLEMENT OF NICKEL ALLOYS AFTER NEUTRON IRRADIATION. Boehm, H.; Hauck, H.; Laue, H. J. (Kernforschungszentrums, Karlsruhe, Ger.). Metall, 22: 1192-6(Dec. 1968). (In German).

The irradiation behavior of 3 nickel alloys, Inconel 625, Hastelloy X, and Inconel 718, is reported. The irradiations were carried out in the Br-2 reactor at ~50°C with a neutron dose of 2×10^{21} n/cm^2. The alloys were tested in the as-received state as well as in a state achieved by 50% cold deformation followed by annealing at 700°C for 400 hr. The tensile tests were carried out between 600 and 750°C. The mechanical-thermal pretreatment resulted in an increase in the yield strength and tensile strength. The reduction in fracture after irradiation, appearing in this temperature region, was decreased by the mechanical-thermal treatment. Data are presented in graphs. (M.C.G.)

34046 NEUTRON IRRADIATION EFFECTS ON THE PLASTIC PROPERTIES OF PURE IRON. Kitajima, K. (Kyushu Univ., Japan). Trans. Jap. Inst. Metals, 9: Suppl., 182-6(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

Stress-strain characteristics together with internal frictions were measured on pure iron single crystals containing <0.1, 1 and 20 ppM carbon and irradiated to doses of 0, 1.8×10^{17}, 1.3×10^{18} and 1×10^{19} nvt (>1 MeV) at temperature ~70°C. The increases of yield stress at small strain and subsequent flow stress at larger strain were interpreted as caused mainly by barriers of irradiation defects against the movements of edge and screw dislocations respectively based on the standpoint that the latter has much larger Peierls stress than the former. Appreciable decrease of activation volume associated with the flow stress observed in irradiated specimens was attributed to the process of screw dislocation overcoming Peierls hill near the top of irradiation defects of sufficiently small size, presumably such as triplet of interstitials or small dislocation loop invisible by electron microscope. The increase of the flow stress estimated from the present view is shown to coincide with the observed value. The contents of carbon were found not to have large effects on hardening in as irradiated condition within the dose of $<1.3 \times 10^{18}$ nvt, though they gave large effects in the course of recovery of yield stress and internal friction after annealings. The explanations are presented for these evidences based on the mechanisms of trapping and detrapping of carbon atoms to vacancies and other defects during annealing. (auth)

34047 RADIATION HARDENING IN bcc METALS NIOBIUM AND IRON. Ohr, S. M.; Tucker, R. P.; Wechsler, M. S. (Union Carbide Corp., [Oak Ridge, Tenn.]). Trans. Jap. Inst. Metals, 9: Suppl., 187-92(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

The effect of neutron irradiation on plastic deformation in single crystal niobium and polycrystalline iron is discussed. The following experimental results are presented: (1) the temperature and strain rate dependencies of the yield stress, (2) direct observations in niobium of radiation damage and slip bands by transmission electron microscopy and (3) the size distribution of the defects following doses of 5×10^{17} and 2×10^{18} neutrons/cm^2 ($E > 1$ MeV). The hardening is found to be due primarily to an increase in the athermal component of stress. From thermal activation analysis there is an indication of slight increase in the activation energy while the activation volume hardly changes following irradiation. Thus irradiation does not appear to effectively alter the thermally activated motion of dislocations. Consequently the observation of defects identified as dislocation loops and channels swept clean of defects led to an analysis of radiation hardening by contact elastic interaction between dislocations and the loops. It is found that a strong barrier model is in good agreement with the experimentally

observed increase in yield stress. Thus it is concluded that the major factor contributing to radiation hardening in the bcc metals is the short range elastic interaction between radiation induced dislocation loops (diameters >50 Å) and dislocations set in motion during deformation. (auth)

34048 ELECTRON IRRADIATION STRENGTHENING IN METALS AND ALLOYS. Meshii, M. (Northwestern Univ., Evanston, Ill); Mifune, T.; Ono, Kanji. Trans. Jap. Inst. Metals, 9: Suppl., 193-9(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

The effects of electron irradiation below 31°K on mechanical behavior of copper, aluminum, and aluminum−1 at. % zinc single crystals were examined during tensile deformation below 25°K. The incident energy of electrons was 2 MeV for copper and 1 MeV for aluminum and aluminum−1 at. % zinc. The flow stress and strain rate sensitivity of flow stress increased proportionally with the square root of the electron dose. The irradiation also increased the extent of the easy glide and promoted the overshooting phenomenon. All of the observations were consistent with the dispersed barrier model in which the obstacles are the irradiation-induced interstitialcies dispersed randomly. The work hardening mechanisms for the easy glide and the linear hardening regions were examined, using the irradiation effects. The continuous activity in the secondary slip systems was essential for the high rate of work hardening in the linear hardening. The irradiation suppressed the secondary slip activity unless the tensile axis reached the ⟨100⟩ − ⟨111⟩ symmetry line before the irradiation. The recovery of the electron irradiation strengthening was also examined. A large Stage I recovery (~60%) found in aluminum was reduced to approximately 20% by the addition of zinc atoms. No significant recovery and an appreciable recovery were found in Stage II annealing in aluminum and the aluminum−zinc alloy, respectively. The irradiation strengthening disappeared completely at Stage III annealing for both specimens. Vacancy interstitialcy recombination was the predominant recovery mechanism in Stage I The strengthening remaining after Stage I recovery was attributed to trapped interstitialcies in the aluminum−zinc alloy. Copper showed appreciable recovery in Stage I and some recovery in Stage III. Complete recovery was not attained at Stage III. (auth)

34049 STRENGTHENING IN NEUTRON IRRADIATED COPPER SINGLE CRYSTALS AFTER MILD ANNEALING. Koppenaal, T. J. (Philco–Ford Corp., Newport Beach, Calif.). Trans. Jap. Inst. Metals, 9: Suppl., 200-5(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

The thermally activated rate controlling mechanism for slip in neutron irradiated copper single crystals given post-irradiation annealing at 306°C was investigated. Measurements are made of the temperature dependence of the flow stress at constant strain rate, and the strain rate dependence of the flow stress at constant temperature. The activation enthalpy for slip is determined as a function of effective stress, and the results indicate that H_0, the enthalpy at zero effective stress, is independent of the annealing at 306°C. The stress dependence of both the activation enthalpy and the activation volume in the post-irradiation annealed crystals is in agreement with Fleischer's theory for strengthening by tetragonal distortions. A low temperature athermal deformation process is observed in these crystals, and this observation helps to explain some of the previous conclusions regarding the deformation mechanism in post-irradiation annealed crystals. It is concluded that the post-irradiation annealing at 306°C does not change the thermally activated rate controlling slip mechanism. In addition, the effective obstacle size remains constant, independent of the annealing. (auth)

34050 STRENGTHENING MECHANISM IN NEUTRON IRRADIATED GOLD AND SILVER SINGLE CRYSTALS. Koppenaal, T. J. (Philco–Ford Corp., Newport Beach, Calif.). Trans. Jap. Inst. Metals, 9: Suppl., 205-9(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

The nature of radiation damage by high energy neutrons in gold and silver has been investigated by determining various strength parameters. Measurements have been made of stress-strain curves, isochronal annealing behavior, temperature dependence of the flow stress, and a thermal activation analysis of the rate controlling slip mechanism. Qualitative comparisons show that neutron irradiated gold and silver crystals are very similar to irradiated copper. The basic dislocation-defect interaction responsible for the strengthening is also shown to be the same in these metals. A quantitative comparison between gold and copper shows that for a constant neutron dose there are more defects in copper, but the defects are larger in gold. (auth)

34051 EFFECT OF TEMPERATURE DURING NEUTRON IRRADIATION ON SUBSEQUENT DEFORMATION IN THE Zr–2.5 WT PERCENT Nb ALLOY. Ells, C. E.; Williams, C. D. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. Jap. Inst. Metals, 9: Suppl., 214-19(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

The effect of temperature during neutron irradiation on post-irradiation deformation behavior was studied using an annealed Zr−2.5 wt % Nb alloy. Tensile specimens oriented for deformation by slip were irradiated at 50 to 100°C and 250 to 325°C. After irradiation to integrated neutron fluxes of $\sim 5 \times 10^{19}$ n/cm^2 (E > 1.0 MeV) transmission electron microscopy revealed small clusters or loops ~25 Å diameter in material held in the lower temperature range, with some cluster or loops ~100 Å diameter in material held in the higher temperature range. The defects generated at ~300°C were responsible both for a larger increment in yield stress and a higher rate of work hardening than the defects formed at the lower temperature. A reasonable correlation is obtained between the changes in deformation characteristics and the defects formed during irradiation. (auth)

34052 NEUTRON IRRADIATION HARDENING OF IRON SINGLE CRYSTALS CONTAINING SMALL AMOUNTS OF CARBON. Diehl, J. (Max-Planck-Instutut fuer Metallforschung, Stuttgart); Seidel, G. P.; Weller, M. Trans. Jap. Inst. Metals, 9: Suppl., 219-25(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

Single crystals of iron with two different carbon concentrations (20 and ≲8 wt-ppM) were deformed in tension before and after neutron irradiation up to a neutron dose of $2 \cdot 10^{18}$ n/cm^2. The dependence of the yield stress on neutron dose, deformation temperature, and strain rate are analyzed in detail. Different methods of describing and analyzing these dependencies are critically compared. In the unirradiated crystals, the interaction of dislocations with carbon atoms in solution controls the temperature and strain rate dependence of the yield stress. It can be concluded that before irradiation in both types of samples the same concentration of carbon is in solution, which is only a part of the total carbon content. It is suggested that due to the irradiation the originally undissolved carbon becomes dispersed in the lattice and that complexes of carbon atoms and vacancies or Fe-interstitials are formed, which act as the predominant dislocation obstacles. (auth)

34053 IRRADIATION HARDNESS IN COPPER. Blewitt, T. H.; Arenberg, C. Arne (Argonne National Lab., Ill.). Trans. Jap. Inst. Metals, 9: Suppl., 226-33(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

The effects of fast neutron bombardment on the yield stress of fcc metals were studied. The purpose of these studies is to resolve the controversy relating to the dose dependence of the yield stress, i.e., whether the yield stress (τ) increases as the dose to the one-third power or whether the increase in yield stress ($\Delta\tau$) increases as the one-half power of the dose with a saturation term. This controversy can be settled by studying at very low temperatures the dose dependence of crystals of low initial yield stress at very low neutron doses. A tensile machine was designed to operate in the CP-5 fast flux facility in a bath of liquid helium so that yield stress could be determined at 4.2°K with warmup of the sample. The tensile machine has a strain sensitivity of 10^{-6} cm/cm so that micro-yield stresses can be observed. The macro-yield stress ($\Delta l/l > 10^{-4}$) of copper crystals irradiated at 4.2°K varies with 0.333 power of the neutron dose for doses (E > 0.5 MeV) ranging from 2.5×10^{14} (7 min full power operating time) to 3.6×10^{17} n/cm^2. Experiments at doses between 7×10^{12} and 4×10^{13} show that the change in yield stress ($\Delta\tau$) is not proportional to the dose to the half power. On the other hand, τ_{irrad} determined from the cube root of the difference between τ^3_{meas} and τ^3_i shows a direct proportionality to the one-third power of the dose. The micro-yield stress of copper single crystals irradiated at 4.2°K shows a small, if any, increase in the yield stress for doses less than 5×10^{15}. For doses from 5×10^{15} to 5×10^{16} the micro-yield stress increases as the third power of the dose. Annealing experiments show that less than 1% recovery occurs between 4.2 and 100°K. It should be noted that about 50% of the radiation-induced resistivity recovers in this range. (auth)

34054 RECOVERY IN COPPER AFTER NEUTRON IRRADIATION AT LIQUID HELIUM TEMPERATURE. Okuda, S.; Nakanii, T.; Takamura, S.; Maeta, H. (Japan Atomic Energy Research Inst., Tokai, Japan). Trans. Jap. Inst. Metals, 9: Suppl., 234-7(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

An in-pile irradiation facility at liquid helium temperature was

briefly described. The study on the recovery of pure copper after fast neutron irradiation in this loop was made by means of internal friction and modulus measurements. The dislocation depinning was observed during thermal annealing. The depinning was demonstrated by the modulus decrease and the growth of the dislocation relaxation peaks. Interstitial type defects around dislocation lines were absorbed by the depleted zones during annealing and thus the depinning resulted. The depinning occurs nonuniformly among the dislocations of different types. Also, a transient change in the internal friction and modulus at low temperature was observed, which may be attributed to the pinning and depinning process. (auth)

34055 PROPERTIES OF HEAT-RESISTING STEELS AFTER HIGH TEMPERATURE REACTOR IRRADIATION. Votinov, S. N.; Grintchuk, P. P.; Khoudyakov, A. V.; Ostrovskii, S. E.; Prokhorov, V. I. (Scientific Research Inst. of Atomic Reactors, Ulyanovsk, USSR). Trans. Jap. Inst. Metals, 9: Suppl., 238-41(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

Effect of high temperature reactor irradiation on room-temperature and high-temperature strength was investigated on heat-resisting austenitic steels of 15–35. Considerable depression of all mechanical properties occurs after irradiation at the dose of 2×10^{20} n/cm^2 ($E \geq 1$ MeV). Embrittlement at 650 and 750°C is removed by post-irradiation annealing which, however, leads to further decreasing of material strength. Results of mechanical tests and observation of microstructures under optical and electron microscope magnification indicate that intensive aging during irradiation was responsible for the decrease in properties of 15–35 steels after high temperature irradiation but not helium mechanism. (auth)

Ceramics and Cermets

Refer also to abstract 33922.

34056 CERAMIC URANIUM DIOXIDE NUCLEAR FUEL BODY. (to United Kingdom Atomic Energy Authority). French Patent 1,464,489. Filed Jan. 19, 1966.

A fuel body consisting of a fritted ceramic UO_2 is described. In order to prevent undesired growth of the grains in longitudinal direction when subjected to high temperature-gradients at temperatures above 1600°C, the UO_2 powder is mixed with 0.5 to 5 wt % of Y_2O_3 powder before compacting and fritting. (NPO)

Corrosion and Erosion

34057 APPARATUS USING ^{14}C LABELLED MATERIALS AND AUTOMATIC RADIO–GAS CHROMATOGRAPHY TO INVESTIGATE THE CARBON DIOXIDE–CARBON REACTION IN REACTORS. Dominey, D. A.; Feates, F. S. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., E (London), 2: 591-6(July 1969).

Equipment is described for use in a range of experimental positions in the DIDO and BEPO reactors at Harwell which enables the oxidation of carbon-14 labeled graphite by radiolyzed gases to be measured by chemical and radiochemical methods. Provision is made for accurate calorimetric measurement of absorbed dose and for the effects of differences of radiation spectrum to be investigated. Solid radiolysis products can be heated separately so that they can be analyzed as effluent gases. Fully automatic in-line radio-gas chromatographs are described. Calibration methods are shown, together with typical results. (auth) (UK)

34058 METHOD OF INHIBITING THE CORROSION OF GRAPHITE IN NUCLEAR REACTORS. (to Commissariat a l'Energie Atomique). French Patent 1,411,900. Filed Aug. 14, 1964.

A method of inhibiting the corrosion of graphite in graphite-moderated, CO_2-cooled nuclear reactors is described. The method consists of the addition to the coolant of a suitable quantity of carbon oxide, watergas, hydrogen, hydrocarbons, or coal gas. (NPO)

34059 METHOD OF INHIBITING THE CORROSION OF GRAPHITE IN NUCLEAR REACTORS. (to Commissariat a l'Energie Atomique). French Patent 1,418,140. Filed Oct. 1, 1964.

A method of inhibiting the corrosion of graphite in graphite-moderated, CO_2-cooled nuclear reactors is described. The method comprises the addition to the coolant of at least one reducing-agent which contains oxygen, preferably selected from the group constituted by the aldehydes, ketones, and organic acids. (NPO)

34060 METHOD OF INHIBITING THE CORROSION OF GRAPHITE IN NUCLEAR REACTORS. (to Commissariat a l'Energie Atomique). French Patent 1,400,509. Filed Apr. 15, 1964.

A method is described for inhibiting the corrosion of graphite in graphite-moderated, CO_2-cooled nuclear reactors. The method comprises the addition to the coolant of a gaseous hydrocarbon or a gaseous mixture containing at least one hydrocarbon e.g. methane, natural gas, or coal-gas. (NPO)

Preparation and Fabrication

Refer also to abstract 34092.

34061 ENTHALPIES OF FORMATION OF TRIURANIUM OCTAOXIDE AND URANIUM DIOXIDE. Huber, Elmer J. Jr.; Holley, Charles E. Jr. (Los Alamos Scientific Lab., N. Mex.). J. Chem. Thermodyn., 1: 267-72(May 1969).

The enthalpies of formation of triuranium octaoxide and uranium dioxide were determined by oxygen bomb calorimetry and found to be $\Delta H_f^\circ(U_3O_8, 298.15°K) = -(854.4 \pm 0.6)$ kcal mol^{-1} and $\Delta H_f^\circ(UO_2, 298.15°K) = -(259.3 \pm 0.2)$ kcal mol^{-1}. (auth) (UK)

34062 FABRICATION OF SPHERES OF CONTROLLED SIZE FROM POWDER MATERIALS BY A PLANETARY ROLLING TECHNIQUE. Williams, G. H. (Atomic Energy Research Establishment, Harwell, Eng.). Proc. Brit. Ceramic Soc., No. 12, 179-92(Mar. 1969).

From Proceedings of the British Ceramic Society, Leeds, Eng. See CONF-670984.

A technique has been developed for forming and building up 0.1 mm seed spheres to sizes from 0.25 to 5 mm dia. The starting material consists of a granulated mixture of the required powders and a uniformly dispersed liquid binder. The binder content of the feed material is varied during the stages of granulation. The principal virtue of the method lies in the excellent yield obtained of large spheres having adequate strength and density and with good shape and smooth surface. The product from planetary rolling can be sieved and handled freely before and after removal of the binder. Spheres of UO_2, UO_2/C, carbon black, WC, W, Al_2O_3 and Al_2O_3/Ni have been made. The method appears versatile and many powders can be used provided that the correct levels of binder have been determined. (auth)

34063 CONTINUOUS HOT-PRESSING TECHNIQUE. Oudemans, G. J. (Philips Research Labs., Eindhoven, Netherlands). Proc. Brit. Ceramic Soc., No. 12, 83-98(Mar. 1969).

From Proceedings of the British Ceramic Society, Leeds, Eng. See CONF-670984.

A machine has been developed by means of which several oxide powders have been hot-pressed into ceramic rods with less than 1% porosity and with diameters of about 20 mm and lengths of more than 50 cm. In principle the method allows the production of a cylindrical rod of unlimited length and arbitrary cross-section. The maximum temperature and maximum pressure which were applied simultaneously in the die of dense alumina are 1400°C and 2000 kg/cm^2 respectively. The machine operates fully automatically. In describing it emphasis is given to the construction of the die. The surface of the produced rods is shiny and smooth. The size tolerance on a diameter of 17 mm is better than 5 μm. The grain size of the material can be kept down to that of the starting powder. The results obtained so far are surveyed and the prospects of this technique are considered, especially with regard to the industrial application of hot-pressing. (auth)

34064 THERMOMECHANICAL PROCESSING OF CERAMICS. Spriggs, R. M. (Lehigh Univ., Bethlehem, Pa.); Runk, R. B.; Atteraas, L. Proc. Brit. Ceramic Soc., No. 12, 65-82(Mar. 1969).

From Proceedings of the British Ceramic Society, Leeds, Eng. See CONF-670984.

Hot-forming processes are outlined, including decomposition pressure sintering, reactive hot pressing, phase-inversion pressure sintering, liquid-phase pressure sintering and extrusion forming, thermomechanical processing, single-crystal growth by strain annealing, and the pressure bonding of polystructural single-phase composites. Synergetic press-forging techniques such as phase-transformation press-forging are also considered. Attempts to define the mechanisms of pressure-sintering densification and press-forging deformation by considering the simultaneous occurrence of phenomena such as particle rearrangement, fragmentation, grain-boundary sliding, diffusional creep, and, in particular, plastic flow by dislocation motion are referred to. (auth)

34065 PROCESSING BERYLLIA POWDER FOR SINTERING TO HIGH DENSITY. Denton, I. E.; Matkin, D. I.; Hill, N. A. (Atomic Energy Research Establishment, Harwell, Eng.). Proc. Brit. Ceramic Soc., No. 12, 33-9(Mar. 1969).

From Proceedings of the British Ceramic Society, Leeds, Eng. See CONF-670984.

Beryllia bodies >99% density have been sintered from commercially available powders treated by a controlled calcination and ball milling procedure. (auth)

34066 CALCINATION PROCESSES IN OXIDES. Hey, A. W.; Livey, D. T. (Atomic Energy Research Establishment, Harwell, Eng.). Proc. Brit. Ceramic Soc., No. 12, 13-31(Mar. 1969).

From Proceedings of the British Ceramic Society, Leeds, Eng. See CONF-670984.

Oxide powders calcined at various temperatures have been characterized by examination in the electron microscope, the determination of BET surface areas and by the analysis of adsorption/desorption isotherms. With beryllia a crystal growth process predominates whereas thoria, both as relic particles obtained from thorium oxalate and in gel form, undergoes densification. (auth)

34067 FABRICATION SCIENCE 2. Proceedings of the British Ceramic Society, Leeds, England, 18–20 September 1967. Proc. Brit. Ceramic Soc., No. 12, 1-255(Mar. 1969). (CONF-670984).

Twenty papers were presented at the meeting. A separate abstract was prepared for each of six papers. Papers for which no abstracts were prepared are concerned with ceramic fabrication, Mn–Zn ferrite, chemical bonds, effects of gaseous impurities on ceramics, sintering alumina, sintering glass, vibration pressing, fabrication of ceramic tubes, pressing techniques, electrophoretic deposition, alumina deposition, densification of NaCl, and sintering ZnO. (J.R.D.)

For abstracts of individual papers see: 34062–34066 and 34087.

34068 SILICONATED PYROLYTIC GRAPHITE. PART 1. PREPARATION AND SOME PROPERTIES. Yajima, Seishi; Hirai, Toshio (Tohoku Univ., Sendai). J. Mater. Sci., 4: 416-23(May 1969).

Siliconated pyrolytic graphite PG(Si) was prepared by pyrolysis of a mixture of propane and silicon tetrachloride vapor at 1440 to 2025°C, a total gas pressure of 10 or 50 torr, and a partial pressure of silicon tetrachloride vapor of up to 13 torr. The amounts of silicon in PG(Si) were 0.02 to 4 wt %. The effects of the addition of silicon tetrachloride on the surface characteristics, the microstructure and the density of PG(Si) were examined. (auth) (UK)

34069 KINETICS OF THE FORMATION OF BORIDES OF MOLYBDENUM, TUNGSTEN, AND RHENIUM FROM BORON NITRIDE–METAL POWDER MIXTURES. Baehren, F. D.; Thuemmler, F.; Vollath, D. (Univ., Karlsruhe, Ger.). J. Less-Common Metals, 18: 295-303(July 1969). (In German).

The course of the reactions between boron nitride and the metals molybdenum, tungsten, and rhenium has been studied with the aid of a thermobalance. It has been shown that the formation of the borides MoB, WB, and ReB_2 follows that of any possible lower borides. These reactions, as in the case of molybdenum, can take place either almost simultaneously or in clearly defined steps. The activation energies have been estimated, by the method of Sizmann and Frank, by an analysis of the reaction–time curves obtained under controlled conditions. A review of the reactions and activation energies is given in a table. (auth)

34070 CERAMIC FUEL MATERIALS. Denton, Ivor Edison (to United Kingdom Atomic Energy Authority). U. S. Patent 3,442,762. May 6, 1969. Priority date June 21, 1966, Great Britain.

A nuclear fuel of the dispersed type is described. It is characterized by fuel particles each coated with porous beryllia located in a preferably slip-cast, matrix. The elements are canned in beryllia of nearly theoretical density. (Offic. Gaz.)

34071 FABRICATION OF BORON TRIOXIDE DISCS OF WELL DEFINED THICKNESS. Oberparleiter, R.; Bensch, F. (Osterreichische Hochschule, Vienna). J. Nucl. Energy, 23: 305-6(May 1969).

Boron trioxide discs are cast in a stainless steel mould after annealing in a platinum crucible at 600 to 700°C. The dehydrated B_2O_3 is heated in the mould at 600°C for 30 min, and for a further 30 min under the weight of the die. Adhesion of the sample to the die and mould is prevented by the use of Al foil and "Molykote" mould lubricant. (UK)

34072 STUDY OF FABRICATION OF ALUMINUM-ALLOY-CLAD FLAT FUEL ELEMENTS WITH CERMET CORES (65% U_3O_8–35% Al). Capocchi, Jose Deodoro Trani; Cintra, Sebastiao Hermano Leite; Gentile, Erberto Francisco. Met., ABM (Ass. Brasil. Metais), 24: 913-18(Dec. 1968). (In Portuguese).

Fuel elements with a core density 79.5% of the theoretical, a total thickness of 1.45 ± 0.02 mm and a perfect bond between core and cladding have been produced. Cladding material used is 1100 Al. Starting materials, processing parameters, and intermediate and final products are described. The fuel plates are still being evaluated. The use of fuel elements, whose cores are formed from dispersions of U_3O_8 in Al in various types of nuclear reactors, is discussed. (Metals Abstr.)

34073 METHOD OF MAKING AND ASSEMBLING NUCLEAR FUEL ELEMENTS. (to Rolls-Royce Ltd.). French Patent 1,335,875. Filed Oct. 10, 1962.

A method is described for making a fuel element with the inner wall of a stainless steel sheath deposited with Ni or a Ni–P-alloy, coating with Ni by vapor deposition a mass of fissile material containing U-monocarbide, -nitride, or -dioxide, encasing the material in the sheath, creating a high vacuum within the sheath so as to remove substantially all O_2. Heating the whole to a temperature of 800 to 1050°C forms a diffusion bond between the Ni-coatings on the sheath and the fissile material. The sheath is made initially larger than the mass of fissile material and is collapsed into contact therewith under external pressure, the excess metal of the sheath resulting from the collapsing forming at least part of projections on the surface of the fuel element. The elements have the form of elongate members of wedge-shaped cross-section and are assembled by disposing them radially in an annular casing, each of the elements being bonded to the inner walls of the casing and to adjacent elements by partly cylindrical projections extending from their sheaths. (NPO)

34074 PROCESS FOR THE MANUFACTURE OF NUCLEAR FUEL PLATES. (to United Kingdom Atomic Energy Authority). French Patent 1,479,149. Filed May 10, 1966.

A process is described for the manufacture of fuel plates by forming a circular disc which is composed of alternating sectors of a nuclear fuel alloy such as an U-alloy, and an Al-alloy sheathing material, the sectors being united by electron-beam welding. The disc is machined to obtain a sleeve having alternating cylindrical portions of fuel and sheathing material. The sleeve is interposed between an outer and an inner layer of sheathing material. The assembly is extruded to form a composite tube. The tube is split lengthwise through the sheathing material to obtain arcuate fuel plates which may be rolled flat. A portion of the surfaces of inner and outer sleeves is anodized by the chromic acid process to improve the metallurgical bond at the interfaces. The assembly is swaged in a counter direction to the direction of extrusion to remove any radial clearance between its components. The assembly is dehydrated by heating at a temperature of 625°C for at least 2 hours. (NPO)

34075 IMPROVEMENT IN THE PRODUCTION OF CERAMIC NUCLEAR FUELS. (to Commissariat a l'Energie Atomique). French Patent 1,515,085. Filed Dec. 22, 1966.

A process for the production of ceramic nuclear oxide fuels having a relatively high heat conductivity is described. Finely divided oxide such as UO_2, PuO_2 or ThO_2, having a surface area of 10 to 15 m^2/g is compressed into compacts at a pressure of 1500 kg/cm^2. The compacts are granulated to a particle size of 140 to 280 μ. The granules are mixed with a quantity, preferably 10 to 20 wt %, of a finely divided metal such as W, Mo, Fe, Ni, Cr, or V, having a particle size of about 1 μ and cold compressed at 2000 to 5000 kg/cm^2. The compacted mixture is then sintered in a suitable atmosphere, preferably H_2, at a temperature in the range 1200 to 1600°C. If the fissionable material is UO_2 the admixed metal preferably consists of Fe which has been stabilized in the α-phase by the addition of about 5 wt % of W, Si or Ge. (NPO)

34076 PROCESS FOR THE PRODUCTION OF A NUCLEAR FUEL BODY. (to United Kingdom Atomic Energy Authority). French Patent 1,437,046. Filed June 8, 1965.

A fuel body for a nuclear reactor is prepared by taking a U-nitride or U-carbonitride powder having all particles in the size range 0.1 to 5 μ, a N- or a N-plus C-content in the range 48 to 52 at. % and an O-content below 1 wt %, compacting the powder into pellets and sintering the pellets in an inert atmosphere containing less than 10 ppM of O and 10 ppM of H_2O. Preferably the sintering is effected at a temperature in the range 1450 to 1700°C in an Ar-atmosphere containing less than 2 ppM of O and 2 ppM of H_2O. In a modification U-carbide powder is mixed with the U-nitride prior to compacting. For use in a fast reactor a Pu-compound may be included in the fuel body by mixing Pu-nitride with the U-nitride or Pu-carbonitride with the U-carbonitride. For use in a breeder reactor a Th-compound may be included in the fuel body by mixing Th-nitride with the U-nitride or Th-carbonitride with the U-carbonitride. (NPO)

34077 PROCESS FOR COATING URANIUM CARBIDE PARTICLES. (to United Kingdom Atomic Energy Authority). French Patent 1,424,019. Filed Dec. 23, 1964.

A process is described for the production of high integrity spheroids of U-carbide having an outer coating of fission product retaining refractory material. An initial thin coating of pyrolytic C is applied to spheroids of UC at a deposition temperature in the range 1200 to 1400°C such that reaction between the pyrolytic C and the UC does not take place, followed by application of an outer coating of fission product retaining refractory material at a temperature of 1500°C or above, such that reaction takes place between the initial pyrolytic C coatings and the UC spheroids and, due to this reaction, voidage in the form of a gap is produced between the spheroids and their outer coatings. Preferably the outer coating consists of pyrolytic C deposited at a temperature in the range 1500 to 1800°C. In a modification an intermediate coating of Si-carbide is applied to the initial pyrolytic C coating at a deposition temperature similar to that at which the latter was applied, and finally an outer coating of Si-carbide is deposited at a temperature in the range of 1500 to 1600°C. (NPO)

34078 PROCESS FOR THE PRODUCTION OF SPHEROIDAL PARTICLES OF NUCLEAR FUEL CARBIDES. (to EURATOM). French Patent 1,496,060. Filed July 28, 1965.

A process is described for production of spheroidal particles of nuclear fuel carbides, comprising mixing actinide oxide powders and carbon, the quantity of the latter exceeding the stoichiometric ratio, with a polymerizable binder the thermal decomposition product of which is carbon, granulating the mixture by means of a rotating sieve method, hardening the granules by catalytic action, e.g. with HCl, and vacuum heating the granules at a temperature of about 1800°C to reduce the oxides. In a modification the granules are fluidized in an inert gas, to which as soon as said reduction has taken place, gaseous hydrocarbons are added to form a cladding of pyrolitic carbon on the granules. Preferably the atomic ratio oxide : carbon is in the range 1 : 10 to 1 : 12. (NPO)

34079 PROCESS FOR THE PRODUCTION OF CERAMIC NUCLEAR FUEL BODIES. (to Commissariat a l'Energie Atomique). French Patent 1,434,251. Filed Feb. 22, 1965.

A process is described for the production of ceramic nuclear fuel oxide bodies having an apparent density of 88 to 96% of the theoretical density in consequence of a microstructure in which relatively wide distinct cavities are bounded by non-porous fuel particles. The process comprises compressing the finely divided oxide, having an average particle size not exceeding 0.9 μ and a surface area in the range 4 to 15 m^2/g into compacts at a predetermined pressure and then sintering the compacts by raising the temperature at a predetermined rate dependent on the particle size of the oxide. If the particle size exceeds 0.4 μ the powder is compacted at a pressure in the range 4000 to 6000 kg/cm^2 and the temperature is raised at a rate of 100 to 200°C per hour. If the particle size is below 0.4 μ the powder is compacted at a pressure in the range 2000 to 3000 kg/cm^2 and the temperature is raised to 900°C at a rate of 1000°C per hour and then to 1600°C at a rate of 6000°C per hour. (NPO)

Properties Evaluations

Refer also to abstracts 33371, 33969, 34037, 34064, 34065, 34068, and 34122.

34080 (BMI-X-10231) THERMAL PROPERTIES OF BETTIS-FABRICATED ThO_2–UO_2 FUEL MATERIALS. (LWBR DEVELOPMENT PROGRAM). Springer, J. R.; Lagedrost, J. F. (Battelle Memorial Inst., Columbus, Ohio). Mar. 1, 1968. Contract W-7405-eng-92; Subcontract 73-14-1202. 108p. Dep. CFSTI.

For Bettis Atomic Power Lab., Pittsburgh, Pa.

Thermal-diffusivity measurements were performed on ThO_2–UO_2 reactor fuel materials. The compositions of the materials ranged from ThO_2-3.12 wt % UO_2 to 100 percent UO_2, with densities ranging from 64.9 to 98.4 percent of theoretical. Thermal conductivity was calculated from the diffusivity data with specific heat and linear expansion-density values obtained for the most part from work done in earlier testing. The temperature range of the measurements extended from 300 to 1900°C. The results of measurement were in good agreement with those for similar materials obtained during the earlier work. Thermal-diffusivity values and calculated conductivities decreased in fairly regular fashion with increasing temperature and increasing UO_2 content. Conductivity values ranged from a maximum at 300°C of about 0.07 W/(cm)(°C) to a minimum at 1900°C of about 0.01 W/(cm)(°C). A comparison of the conductivity data with data on Battelle-fabricated ThO_2, ThO_2-10 wt % UO_2, and ThO_2-20 wt % UO_2, is given along with a plot of conductivity versus UO_2 content corrected to zero porosity. (auth)

34081 (BNWL-1015) USE OF DIFFUSION BARRIERS IN REDUCING METAL–METAL INTERACTIONS AT 1100°C. Fullam, H. T. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 1969. Contract AT(45-1)-1830. 17p. Dep. CFSTI.

In fabricating an isotope heat source, design considerations frequently dictate the use of multiple layer of dissimilar metals to contain the fuel. At high temperatures, interdiffusion between the dissimilar metals can endanger the integrity of the source. The use of diffusion barriers is one way of reducing or eliminating the interdiffusion reactions. Aluminum oxide films represent a logical choice for a diffusion barrier. Boron silicide was also suggested as a potential barrier material. In this study both materials were evaluated as diffusion barriers at 1100°C with a variety of metal-metal couples. Aluminum oxide appeared to effectively reduce metal-metal interaction as compared with couples in which no diffusion barrier was present. Boron silicide, on the other hand, apparently was ineffective in reducing the interaction. In some cases it appeared to increase interaction. Based on the results obtained with Al_2O_3, a more detailed study on its use as a diffusion barrier appears warranted. (auth)

34082 (EURAEC-2027) INTERNAL FRICTION IN Fe–Ti–N ALLOYS. Technical Report No. 1. Szabo Miszenti, G. (Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari). May 1968. Contract 074-65-10-TEEI(RD). 35p. (EUR-3981). Dep.

Work Performed under United States–Euratom Joint Research and Development Program.

Two internal friction peaks occurring in the temperature ranges 116 to 166°C and 221 to 242°C at 1 cps, respectively, have been found by nitriding specimens of dilute Fe–Ti alloys (0.04 to 0.6 wt % Ti) with NH_3 at 590°C. Influence from hydrogen and oxygen contamination cannot be conclusively ruled out, however, they are regarded as abnormal peaks probably due to nitrogen interstitials interacting with titanium. The activation energies, determined by the peak temperature shifts with frequency, are 25 and 31 kcal/mole, respectively. Both peaks are suppressed by heating at temperatures higher than 950°C. (auth)

34083 (GA-9309) COMPARISON OF EXPERIMENTAL RESULTS WITH RESPONSE ANALYSIS FOR A MODEL OF A PRESSURE VESSEL. Rashid, Y. R.; Ople, F. S.; Chang, T. Y. (Gulf General Atomic, Inc., San Diego, Calif.). Apr. 18, 1969. Contract AT(04-3)-633. 28p. (CONF-690701-1). Dep. CFSTI.

From International Conference on Model Techniques, London, England.

Experimental data and analytical results are compared for a one-quarter-scale model of a prestressed concrete pressure vessel subjected to an arbitrary test history over a 2-yr period. Tests included sustained prestress, transient, and steady-state temperature distributions; short-time and sustained pressures; and pressure overload up to 1500 psig (105.5 kg/cm^2). The response of the model was calculated using a method of analysis that accounts for concrete creep, cable relaxation, cracking, and steel yielding. The method is an application of the finite element method to nonlinear viscoelasticity and is based on a modified superposition principle. A failure surface for the concrete was postulated on the basis of test results which were independent of time and temperature. Strain, displacement, and tendon load change are compared and discussed. (auth)

34084 (ORNL-tr-2128) ESTIMATE OF STRESSES IN THE COATING OF COMPRESSED COATED PARTICLES. Delle, W.; Drittler, K.; Haag, G.; Schiffers, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe). Translated for Oak Ridge National Lab., Tenn., from report JUL-569-RW. 26p. Dep. CFSTI.

The state of stress in the outer layers of a coated particle which is compressed between two planes can be calculated with the theory of elastic shells. Among other things, this permits the derivation of a formula for the determination of the rupture stress from the rupture load and the geometrical dimensions of a particle. Experiments with particles with pyrolytic carbon coatings which were analyzed according to this relation show a good agreement with the results of tensile tests with pyrolytic carbon disks. (auth)

34085 GLASS FORMATION IN THE SYSTEM Cs_2O–Nb_2O_5. Marfels, H. (Max-Planck-Institut fuer Silikatforschung, Wuerzburg, Ger.). Naturwissenschaften, 56: 283(May 1969). (In German).

The glass formation in the system Cs_2O–Nb_2O_5 occurred between 30 and 47 mole % Nb_2O_5 and the most suitable composition was at 41.7 mole %. Infrared spectral studies were carried out. (M.C.G.)

34086 ENTHALPY AND HEAT CAPACITY OF THE SESQUIOXIDE OF GADOLINIUM AT HIGH TEMPERATURES. Tsagareishvili, D. Sh.; Gvelesiani, G. G.; Yashvili, T. S. (Inst. of Metallurgy, Tbilisi, USSR). Zh. Fiz. Khim., 43: 882-5(Apr. 1969). (In Russian).

In a massive calorimeter with an isothermal envelope the enthalpy of the C and B modifications of Gd_2O_3 was measured in the ranges 298.15 to 1472.1 and 298.15 to 1613.3°K and equations for their enthalpies and heat capacities in relation to temperature were obtained. (tr-auth)

34087 DENSIFICATION PROCESSES OF ACTINIDE IVA–VIA COMPOUNDS. Kruger, O. L.; Moser, J. B. (Argonne National Lab., Ill.). Proc. Brit. Ceramic Soc., No. 12, 125-43(Mar. 1969).

From Proceedings of the British Ceramic Society, Leeds, Eng. See CONF-670984.

Procedures for the densifying of compounds of uranium and plutonium which have the NaCl-type crystal structure, high melting-points and high fissile fuel densities are described. The monocarbides, monophosphides and monosulfides were of primary interest. Powders of these materials were compacted by uniaxial cold-pressing and sintering and by hot pressing. Compacts were sintered in vacuum and in flowing high-purity argon at 1 atm pressure. The sintering rate of the cold-pressed powders was volume-diffusion-controlled but complicated by effects of particle orientation or stresses introduced during pressing. The microstructures of the sintered compacts showed that significant grain growth and pore spheroidization had occurred at 2000°C for PuP and 1900°C for PuS. On heating to 2100°C the microstructure of $(U_{0.8}Pu_{0.2})C$ was not changed appreciable from the low-temperature structure. Density/time relationships for hot-pressing are reported and discussed. The data were analyzed in terms of a diffusional creep model. (auth)

34088 OBSERVATIONS ON THE CREEP PERFORMANCE AT ELEVATED TEMPERATURES FOR CERTAIN NIOBIUM ALLOYS. Moulin, J.; Cousserans, R.; Alheritiere, E.; Syre, R. Mem. Sci. Rev. Met., 66: 227-32(Mar. 1969). (In French).

A high-temperature vacuum heat treatment gives a better redistribution of the disperse phases. Carbides (Nb, Zr) C are then present with a composition closer to NbC than to ZrC. Fusion in the electron bombardment furnace gives a finer structure than fusion in the arc furnace. (auth)

34089 GRAPHITE AS A CERAMIC MATERIAL. Hofmann, U.; Boehm, H. P. (Univ., Heidelberg). Ber. Deut. Keram. Ges., 46: 178-80(Apr. 1969). (In German).

The points discussed include: the relative stability of graphite and diamond, the equilibrium diagram of carbon, the crystal structure of graphite, its lubricant properties and its hardness; its thermal conductivity, its electrical conductivity: natural graphites; graphite crucibles; synthetic carbon and synthetic graphite for chemical equipment; pyrocarbon; carbon brushes, carbon collectors; fiber and cloth from synthetic carbon and synthetic graphite; pile graphite. (auth)

34090 VANADIUM–COLUMBIUM–TANTALUM ALLOYS. Holtz, Frederick C. Jr. (to Secretary of the Navy). U. S. Patent 3,449,118. June 10, 1969. Filed Nov. 15, 1966.

A vanadium–niobium–tantalum alloy with addition of titanium, silicon and carbon, is characterized by high tensile strength and ductility at a range of temperatures from −320 to 2000°F. (Offic. Gaz.)

34091 FORMATION OF ACTIVE CARBON IN TWIN-CRUCIBLE STUDIES OF VANADIUM CARBONITRIDE SOLUTIONS. Spear, Karl E.; Leitnaker, James M. (Oak Ridge National Lab., Tenn.). J. Amer. Ceram. Soc., 52: 257-62(May 21, 1969).

Twin-crucible experiments with vanadium carbonitride solutions in equilibrium with carbon and nitrogen gas gave evidence for the formation of carbon in a state more energetic than graphite. These studies show that the V(C,N) lattice parameter depends on whether the starting material was vanadium carbide or a mixture of vanadium nitride and graphite. The postulate that a high-energy form of carbon may result from any decomposition or reaction leading to free carbon is discussed relative to metal carbide evaporation and to the decomposition of uranium dicarbide to the sesquicarbide and carbon. (auth)

34092 ATTEMPT TO PREPARE MARTENSITE WITH IMPROVED MECHANICAL PROPERTIES. Habrovec, F.; Skarek, J.; Rys, P.; Kounicky, J. Kovove Mater., 6: 463-70(1968). (In Czech).

The strength and plastic properties of an Fe–Mo–C alloy were improved after double quenching (first from just above the Ac_3 and then from just below the Ac_1) and low-temperature tempering. The favorable mechanical properties of martensite obtained after rapid reaustenitization are the combined results of factors such as interstitial hardening caused by C in solid solution; substitutional hardening from alloying elements; dispersion hardening by the presence of very fine carbides; substructural hardening caused by the fine martensite needles or the influence of an increased number of lattice defects; and low values of the dynamic and static grain-boundary effects, resulting from the high degree of refinement of the martensite particles. Experiments with the Fe–Mo–C alloy confirmed these formulated hypotheses. (Metals Abstr.)

34093 TEMPERATURE GRADIENT INDUCED MIGRATION OF HELIUM FILLED PORES IN KCl. Carter, R. E.; Nadeau, J. S.; Rosolowski, J. H. (General Electric Research and Development Center, Schenectady, N. Y.). J. Nucl. Mater., 30: 166-9(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

The migration of helium filled pores, drilled in KCl single crystals, in a 605°C/cm temperature gradient was photographically recorded. Both the shape and volume of the initial pores changed during migration. Calculations based on a transport mechanism involving surface diffusion or bulk diffusion are not in agreement with the experimental values. However, pore velocities calculated from the vapor transport model are in good agreement with the observed velocities in KCl. (G.M.C.)

34094 APPLICATION OF CHANNELING TECHNIQUES TO FISSION GAS RELEASE STUDIES. Matzke, Hj. (CCR–EURATOM, Ispra, Italy). J. Nucl. Mater., 30: 110-21(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

The application of the channeling effect, i.e. the orientation dependence of the slow-down of energetic charged particles in single crystalline matter, to fission gas release studies from UC and UO_2 is described. Rutherford-backscattering rates of protons, deuterons, or α-particles as well as (d,p) reactions with ^{12}C or ^{16}O showed a strong anisotropy along the ⟨100⟩ direction indicating a high degree of perfection of the UO_2 and UC single crystals employed. In addition, the channeling behavior of UC was used to measure possible slight oxidation and the formation on the UC single crystals of thin surface layers that are expected to affect the release of rare gases. Single crystals of UO_2 and UC were labeled with the only α-emitting rare gas, radon. No appreciable anisotropy in α-emission rate was observed indicating that the gas atoms are not located in single U-, C-, or O-vacancies and do not occupy the big interstitial ($\frac{1}{2}$, $\frac{1}{2}$, $\frac{1}{2}$) sites in UO_2 either. Separate studies on the release of xenon following ion bombardment showed volume diffusion processes at low gas concentrations ($\lesssim 10^{-5}$ at. %) with activation enthalpies of 84 ± 5 kcal/mole for UC and 89 ± 5 kcal/mole for UO_2. Slight deviations in stoichiometry did not affect this release. The data are discussed in terms of a model of the gas migrating in small vacancy clusters. At high gas concentrations, trapping in the form of a retarded release was observed in both UC and UO_2. (auth)

34095 ON THE MECHANISMS OF DIFFUSION IN INERT-GAS BOMBARDED SOLIDS. DIFFUSION THEORY FOR DISCRETE MEDIA. PART V. Kelly, R.; Jech, C. (McMaster Univ., Hamilton, Ont.). J. Nucl. Mater., 30: 122-33(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

Diffusion in inert-gas bombarded solids can be described in terms of five basic processes. Stage IA, provided it is correctly attributed to gas located in high-mobility sites, would be treated using diffusion theory with a trapping term. The total fraction of gas escaping, F_{IA}, should be given by the relation $(F_{IA})^{-1} = 1 + \bar{R}/L$, where $\bar{R}$ is the 1/e range and L is the appropriate diffusion length for trapping. Stage IB, due to gas being swept out by the annealing of bombardment-induced disorder, should occur in an amount F_{IB} given by the relation $(1 - F_{IB})^{-1} \approx 1 + 1.7\ Bt(V_d)^{\frac{1}{3}}/\bar{R}^2$, where Bt is the bombardment dose and V_d is the volume disordered per ion impact. Stage IIA, which is probably due to gas in sites similar to normal substitutional sites, can be safely assumed to be described by the usual diffusion equation. It shows a marked correlation with self-diffusion such that the following is true: $T_{IIA} = (0.86 \pm 0.10)T_{self\text{-}diffusion}$, where T stands for absolute temperature. Stage IIB is similar to IIA except that it appears to involve transient gas-gas or gas-damage interactions. The predicted amount, F_{IIB}, should be given by the relation $(1 - F_{IIB})^{-1} = 1 + \bar{R}/L$, where L is now the diffusion trapping length appropriate to gas-gas or gas-damage encounters. Stage III is generally accepted to reflect the motion of stable, gas-filled bubbles, and should be adequately described by the usual diffusion equation, though with D_{bubble} substituted for D. (auth)

34096 ROLE OF THE O/U RATIO ON THE SINTERING OF UO_2. Lay, K. W.; Carter, R. E. (General Electric Research and Development Center, Schenectady, N. Y.). J. Nucl. Mater., 30: 74-87(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

The sintering of UO_2 is a volume diffusion controlled process. The sintering rate as a function of the concentration of hyperstoi-

chiometric oxygen at the sintering temperature shows the influence of the O/U ratio on the effective uranium diffusion coefficient. Except under atmospheres having a low oxygen capacity, a sintering specimen is in equilibrium with the furnace atmosphere which can therefore be used to set the sample stoichiometry. The resulting diffusion coefficients of stoichiometric material determined from the rate of initial shrinkage of powder compacts are in good agreement with values determined directly from tracer studies. Hyperstoichiometric specimens (O/U = 2.02) show an enhancement of the shrinkage rate and hence the effective diffusion coefficient is several orders of magnitude greater than expected from published diffusion coefficients. (auth)

34097 INFLUENCE OF DEFECTS ON RARE-GAS DIFFUSION IN SOLIDS. Elleman, T. S.; Fox, C. H. Jr.; Mears, L. D. (North Carolina State Univ., Raleigh). Contract AT(40-1)-3508. J. Nucl. Mater., 30: 89-106(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

The diffusion of ^{133}Xe in CsI was studied as an aid to understanding rare gas diffusion in more complex systems, such as nuclear reactor fuels. Diffusion at low gas concentrations and negligible radiation damage levels was measured by growing single crystals of CsI containing radioactive ^{133}I which decayed to ^{133}Xe ($T_{\frac{1}{2}}$ = 20.8 hr). Both the time rate of release and temperature dependence of the rare gas diffusion coefficient were consistent with classical diffusion solutions, giving: $D = D_0 \exp(-Q/kT)$, $D_0 = (0.57^{+\infty}_{-0.1})$ cm²/sec, and Q = (1.01 ± 0.04)eV. Crystals containing high concentrations of defects exhibited trapping of the rare gas and anomalous diffusion kinetics. Trapped gas atoms tended to stabilize the defects and prevent their annealing during heating. Diffusion of fission gas recoiled into CsI specimen surface layers from an external fissionable source obeyed classical diffusion solutions at low fission recoil concentrations, while at high concentrations, radiation damage created traps which decreased gas diffusion rates. These traps differed significantly from natural defects in trap concentration, gas atom binding energies, and annealing characteristics. Increasing the gas concentration independent of radiation damage also lowered rare gas diffusion coefficients, showing that formation of small gas atom clusters also produced trapping. The results showed that classical rare gas diffusion could be obtained under ideal conditions and that distinctive trapping behavior with different characteristics could be associated with the presence of natural defects, radiation damage, and high gas concentration. (auth)

34098 THERMAL DIFFUSION IN CLOSED OXIDE FUEL SYSTEMS. Aitken, E. A. (General Electric Co., Pleasanton, Calif.). J. Nucl. Mater., 30: 62-73(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

Several mechanisms for thermal diffusion in oxide fuels are presented and compared with experimental data. It is shown that gas phase transport along cracks and channels of interconnected porosity is an important aspect of the mechanism. The vapor phase transport path together with oxygen transport via solid phase diffusion provides a dynamically balanced flow of material at steady state which leads to a general relation, $\ln x = Q^*/(RT) + A$, where x is the deviation from stoichiometry, T is the temperature and Q^* is the heat of transport. The values of Q^* are related to the partial molar enthalpies of the constituents involved in the transport mechanism which aid in the selection of a particular mechanism for a given set of conditions. The mechanism which best fits the experimental observations for hypostoichiometric urania is based on a dynamically balanced flow of UO_2 in the gas phase and oxygen in the solid phase. For hypostoichiometric urania-plutonia solid solutions, the mechanism appears to be a dynamically balanced flow of H_2O or CO_2 in the gas phase and oxygen in the solid phase. For stoichiometric and hyperstoichiometric compositions, the mechanism proposed by Markin and Rand seems appropriate. (auth)

34099 OXYGEN AND URANIUM DIFFUSION IN URANIUM DIOXIDE (A REVIEW). Belle, J. (Bettis Atomic Power Lab., West Mifflin, Pa.). J. Nucl. Mater., 30: 3-15(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

Oxygen and uranium self-diffusion coefficients determined experimentally by a variety of techniques are reviewed and compared. In the case of oxygen self-diffusion for essentially stoichiometric UO_2, the expression, $D = 1.15 \exp(-56{,}700 \pm 1000/RT)$ cm²/sec, fits the data for three separate sets of observations covering a range of 10 orders of magnitude in the diffusion coefficient. Variations in the diffusion coefficient and activation energies with composition for UO_{2+x} are not as definitive but are in qualitative agreement with the Thorn–Winslow statistical-mechanical model of a crystal having a perfect cation lattice and anionic vacancies and interstitials. In the case of uranium self-diffusion agreement among the various sets of data for nominally stoichiometric UO_2 is poor. Experimentally determined activation energies range from 70 to about 105 kcal/mole. Two investigations of the effect of composition on uranium self-diffusion coefficients in UO_{2+x} indicate the diffusion coefficient, D, to be proportional to x^2. This behavior is consistent with the theoretical models developed by Lidiard which relates defects in the anion and cation sublattices by way of Frenkel and Schottky products. (auth)

34100 URANIUM AND OXYGEN SELF-DIFFUSION IN UO_2. Marin, J. F.; Contamin, P. (CEN, Grenoble, France). J. Nucl. Mater., 30: 16-25(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

Uranium self-diffusion coefficients in hyperstoichiometric uranium dioxide UO_{2+x} ($0.005 \leq x \leq 0.217$) were determined in the temperature range 1275 to 1650°C by means of the alpha spectrum degradation method. The results can be fitted, in the composition range $0.03 < x < 0.20$, with the Arrhenius equation: $D = 0.13\, x^2 [1 + 10^3 x^3] \exp(-85{,}000/RT)$ cm²/sec. Oxygen self-diffusion in massive UO_2 samples was studied by means of mass spectrometry (using a spark or laser source), proton $^{16}O(p,\alpha)^{15}N$ reaction and ionic mass analyzer. In the temperature range 780 to 1250°C, oxygen diffusion in stoichiometric samples can be represented by the equation: $D = 0.26 \exp(-59{,}300/RT)$ cm²/sec. A considerable enhancement of D with small stoichiometry deviations has been evidenced at 800°C. (auth)

34101 ON URANIUM SELF-DIFFUSION IN UO_2 AND UO_{2+x}. Matzke, Hj. (CCR–EURATOM, Ispra, Italy). J. Nucl. Mater., 30: 26-35(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

Self-diffusion coefficients of uranium in sinters and single crystals of uranium oxide with varying oxygen content were measured between 1200 and 1600°C using the method of α-energy degradation. Carefully determined D-values for UO_2 heated in hydrogen were found to be very low compared to most previously published results, provided the annealing time was long (>100 hr). The most probable reasons for this discrepancy are either the effect of impurities with valences <4 (extrinsic diffusion) or else reduction of the UO_2 to substoichiometry. For UO_{2+x}, higher uranium diffusion coefficients were observed, in accordance with theory and previous results. At 1500°C, the dependence of D on x in UO_{2+x} could be described by $\log D = -10.85 + 1.5 \log x$. A value of 4.8 ± 0.3 eV (110 ± 7 kcal/mole) is suggested as the most probable value for the activation enthalpy of uranium diffusion in UO_2. (auth)

34102 SURFACE DIFFUSION OF OXIDES (A REVIEW). Robertson, W. M. (North American Rockwell Corp., Thousand Oaks, Calif.). J. Nucl. Mater., 30: 36-49(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

The existing data for surface diffusion on oxides have been gathered by two types of measurements: mass transport (grain boundary grooving and scratch smoothing) and tracers. Mass transport methods yield an effective surface diffusion coefficient, without being able to determine directly whether metal ions or oxide ions control the rate of mass transport, while tracer studies measure the diffusion of a single ion. The analysis of the experimental data for both methods must take into account volume diffusion and evaporation-condensation in addition to surface diffusion. Mass transfer measurements on aluminum oxide, magnesium oxide, and uranium dioxide indicate that surface diffusion is dominant over volume diffusion at high temperatures for these oxides. The only tracer measurements of surface diffusion on an oxide to date are measurements on uranium dioxide. Reanalysis of the tracer results indicates the volume diffusion contribution to the tracer motion may be considerable. Small amounts of impurities can greatly affect the apparent surface diffusion coefficient. Departures from stoichiometry can affect the mechanism of material transport by altering the absolute value of the surface diffusion coefficient and its value relative to the volume diffusion coefficient. The validity of models of surface diffusion on oxides is examined in relation to the existing experimental data. (auth)

34103 CERAMIC MATERIAL. Viskov, A. S.; Petrov, V. M.; Venevtsev, Yu. N.; Zhdanov, G. S. Russian Patent 222,232. (In Russian).

A ceramic material containing La_2O_3 and Li_2O is introduced. To increase both the thermal stability and dielectric constant, the material contains niobium pentoxide to satisfy the stoichiometric composition $LaLiNbO_6$. (JPRS)

34104 MICROSTRUCTURE AND MECHANICAL PROPERTIES OF PURE AND BORON-DOPED $VC_{0.88}$. Hollox, G. E.; Venables, J. D. (Martin Marietta Corp., Baltimore). Trans. Jap. Inst. Metals, 9: Suppl., 295-300(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

The mechanical behavior of pure $VC_{0.85}$ and $VC_{0.85}$ doped with boron has been studied over the temperature range 1000 to 1700°C. The critical resolved shear stress for $VC_{0.85}$ is about 25 kg/mm^2 at 1250°C, but this decreases rapidly with increasing temperature to about 3 kg/mm^2 at 1500°C. The strength of undoped $VC_{0.85}$ is anomalously high compared with that of other carbides, possibly because carbon vacancy ordering occurs in this material, and this phenomenon significantly influences dislocation mobility. It was found that the vacancy disordering temperature coincides with the brittle to ductile transition temperature. In boron-doped $VC_{0.85}$, boride precipitates form on {111} and {100} planes, the plane of precipitation being dependent upon boron concentration. These precipitates increase the critical resolved shear stress at 1500°C from about 3 to 19 kg/mm^2. (auth)

34105 DIRECT AND INDIRECT STRENGTHENING EFFECTS OF ThO_2 PARTICLES IN DISPERSION-HARDENED NICKEL. Wilcox, B. A.; Jaffee, R. I. (Battelle Memorial Inst., Columbus, Ohio). Trans. Jap. Inst. Metals, 9: Suppl., 575-9(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

The direct and indirect strengthening effects of second phase particles are examined by comparing the tensile deformation behavior of as-received TD Nickel bar with that of the same material which had been cold-rolled 94% and recrystallized at 1300°C. Over the temperature range 25 to 1200°C, it was found that in the recrystallized material, the particles directly strengthened the alloy in a manner best rationalized by the Orowan mechanism of hardening by nondeforming particles. The shear yield strength, τ, of the recrystallized material thus is given by $\tau = \tau_s + \tau_p$, where τ_s is the matrix yield strength and τ_p is the Orowan stress increment. However, in the case of the as-received TD Nickel bar, there is an additional yield strength increment associated with ThO_2 particles promoting a fine stable fibrous grain and sub-grain structure during fabrication, and thereby indirectly strengthening the alloy. Here the yield strength is given by $\tau = \tau_s + \tau_p + \tau_{se}$, where τ_{se} is termed the strength increment with a high stored energy of cold work. It is shown that approximately one-half of τ_{se} can be attributed to the very fine (stable) grain size in as-received TD Nickel. (auth)

34106 EFFECT OF HYDROGEN ON THE TENSILE PROPERTIES OF ZIRCONIUM. Morozumi, S.; Kimura, A.; Koda, S. (Tohoku Univ., Sendai). Trans. Jap. Inst. Metals, 9: Suppl., 636-42(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

Tensile tests of zirconium-10 to 2815 ppM hydrogen alloys were carried out in the range of 25 to 600°C at a strain rate of 2.2×10^{-4} sec^{-1}. True stress (σ)-true plastic strain (ϵ_p) curves of the alloys, up to 500°C and within 0.1 strain, are divided into two stages, each of which is well represented by the relation: $\sigma = \sigma_0 + K\epsilon_p^m$, where σ_0 and K are constants and m is a strain-hardening exponent. The variations in the extent of the first stage and in the value of m with the hydrogen content and temperature are discussed in connection with microstructures. Data on the tensile properties are also given. (auth)

34107 ON THE STRENGTHENING MECHANISM OF WC–Co ALLOY. Doi, H. (Mitsubishi Metal Mining Co., Ltd., Omiya, Japan); Fujiwara, Y.; Miyake, K. Trans. Jap. Inst. Metals, 9: Suppl., 616-22(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

The WC–Co alloy for a variety of applications contains a very large volume fraction of the carbide particles. One of the important problems concerning the strength of the alloy is the effect of the carbide-to-carbide particle contacts on the mechanical property. Compressive tests and internal friction measurements on several WC–Co alloy specimens with some critical structure, in which the carbide particles occupy 79 to 87 vol %, were investigated. It was found that yielding of the alloy used in this experiment can be largely explained on the basis of Orowan's dislocation by-pass model for alloys containing nondeforming particles, and strain hardening characteristic may also be essentially similar to the one for the dispersion hardened alloy. This concept is not compatible with the view that a continuous carbide skeleton has been formed within the alloy. Due to the very large volume fraction of the carbide phase, however, movements of dislocations in the binder phase are greatly hindered, which results in a very rapid increase of dislocation density in the binder phase with increasing strain. Furthermore, based on the considerations on a sequence of the events to fracture of the alloy, a new concept of fracture of the alloy was proposed whereby the mode of fracture (intergranular or transgranular) is determined by a competition between shear rupture along the intergranular regions and compressive rupture of the carbide particles. The binder content and the carbide particle-size govern which type of the ruptures predominates. (auth)

34108 THEORY OF THE STRENGTH OF TUNGSTEN CARBIDE–COBALT COMPACTS. Nabarro, F. R. N.; Luyckx, Silvana Bartolucci (Univ. of the Witwatersrand, Johannesburg). Trans. Jap. Inst. Metals, 9: Suppl., 610-15(1968).

Experimental data on the strength of tungsten carbide-cobalt compacts are surveyed, and the requirements of a satisfactory theory are indicated. The volume fraction of cobalt f_{Co} and the tungsten carbide grain size L_{WC} are taken as the controlling variables. Results show that the mechanisms of fracture are different for high and low values of f_{Co}. Materials in which the fracture propagates along the interface between carbide and cobalt were not considered. The published models of the fracture process, and some new models, are discussed, and their predictions are compared with the experimental observations. Many of the observations can be given qualitatively satisfactory explanations. At low f_{Co} the strength is controlled by the plasticity of the cobalt layers, which limits the ease of propagation of a crack. The temperature dependence of the strength is not understood. (auth)

34109 STRENGTHENING MECHANISMS OF CARBON-FREE IRON–BORON ALLOYS. Hasegawa, Masayoshi; Okamoto, Masafumi (Waseda Univ., Tokyo). Trans. Jap. Inst. Metals, 9: Suppl., 126-30(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

In view of the similarities of boron to carbon as the alloying element for iron, the strengthening phenomena and mechanisms of carbon-free Fe–B alloys were investigated and compared with Fe–C alloys. Fe–B alloys containing Nb, Mo or W have structures with irregular interfaces over a wide range of cooling rates. The strength of this structure formed by a mechanism similar to bainite in steel is much higher than that of polygonal ferrite. In Fe–B ternary and multicomponent alloys containing Nb, Mo etc. solution-quenched and tempered, there is a high resistance to softening up to ~550°C for 1 hr. This is because of precipitation hardening due to boride and the retardation of decomposition of the quenched structure. Dispersion strengthening by alloy boride particles of 0.1 to 0.5 μ in dia is noted. Fe–B alloys are strengthened by alloying elements and heat treatments. Examples of specimens with higher strength and moderate ductility and toughness are given. (auth)

Structure and Phase Studies

Refer also to abstracts 34001, 34010, 34104, 34122, and 34509.

34110 (AECL–3329) EFFECT OF IRON PRECIPITATES ON MIGRATION OF XENON IN URANIUM DIOXIDE. Perron, P. O.; Morel, P. A. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). May 1969. 22p. Dep. CFSTI. CAN $1.00.

Specimens of sintered uranium dioxide were bombarded with iron-56 ions, then annealed at various temperatures to precipitate an iron-rich phase and subsequently bombarded with xenon at various doses. The presence of iron reduced the xenon release of low dose samples: The temperature required for a given cumulative fractional release increased with increasing precipitation temperature. However, the effectiveness of the precipitates vanished above a transition temperature which approximately equals the temperature at which the precipitates were formed. The effect of iron on the migration of xenon at high concentration in uranium dioxide has also been investigated. Although three precipitation temperatures were used in preparing the samples, the gas-release curves were found to be the same for all the samples. It appeared that the xenon release is higher for iron-containing samples than for precipitate-free uranium dioxide. Subsequent work showed that the high doses of xenon resulted in solution of the precipitate. The higher gas release can be attributed to the higher mobilities frequently observed during phase changes or, in this instance, reprecipitation of the iron. The results indicate that a stable precipitate can reduce xenon release by either trapping the gas or stabilizing other traps such as defect clusters or dislocation loops. However, since irradiation can cause solution of precipitates, the behavior obtained will depend on the stability of the precipitates during irradiation. (auth)

34111 (ORNL-tr-2127) OPTICAL METHOD FOR THE DETERMINATION OF THE LOCAL ANISOTROPY OF PYROLYTIC CARBON LAYERS AND GRAPHITE. Gruebmeier, H. B.; Scheidler, G. P. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe). Translated for Oak Ridge National Lab., Tenn., from a German paper. 17p. Dep. CFSTI.

The anisotropic structure of pyrolytic carbon on coated particles to be used in nuclear fuel elements can be determined by an optical method which measures the intensity of reflected polarized light in two perpendicular directions with a microscope photometer. The degree of orientation can be described by an optical anisotropy factor, which is related experimentally to the BACON anisotropy factor. A theoretical relation has been found between the optical anisotropy factor, the orientation parameter of BOKROS and the BACON anisotropy factor, which fits the experimental values. (auth)

34112 SYNTHESIS AS MONOCRYSTALS AND CRYSTALLINE STRUCTURE OF THE OXIDE $UTiNb_2O_{10}$. Chevalier, Raymond; Gasperin, Madeleine (CNRS, Paris). Compt. Rend., Ser. C, 268: 1426-8(Apr. 21, 1969). (In French).

The structural study of $UTiNb_2O_{10}$ was carried out on a crystal cut in the form of a sphere and led to a factor "R" = 0.04. This oxide belongs to the series $U^{4+}(Ti_x, Nb_{1-x})^4Nb_2^{5+}O_{10}$ with $O \leq x \leq 1$. A mechanism is proposed to account for the nonstoichiometry of UNb_3O_{10} and that of $UTiNb_2O_{10}$. (tr-auth)

34113 NbC- AND HfC-CONTAINING CERMETS AND CERMETED CARBIDES. Kieffer, R.; Trabesinger, G.; Reiter, N. (Technische Hochschule, Vienna). Planseeber. Pulvermet., 17: 25-35(Apr. 1969). (In German).

The pseudoquaternary system TiC–TaC–NbC–WC as well as the pseudoternary system TiC–HfC–WC were examined by x-ray as a basis for NbC and HfC containing cermeted carbides. The pseudoquaternary system consists of the single-phase fcc solid solution, free WC, and a two-phase area which narrows itself at higher temperatures. At 2400°C the highest solubility of WC in the quaternary alloy is about 91 wt %. At temperatures below 1700°C the pseudoternary system contains three two-phase areas and one three-phase area which was not yet described in carbide systems. A miscibility gap surrounded by a one-phase area exists at 1900 to 2000°C. The replacement of TaC with NbC in WC/TiC/TaC cermeted carbides is favorable only up to 30 wt %. HfC can substitute TaC completely. HfC–TaC solid solutions show the best behavior. NbC–HfC solid solutions instead of TaC also gave good results. In the cermeted carbide industry therefore it is now possible to use cheap and sufficiently available NbC instead of the expensive TaC. (tr-auth)

34114 HIGH TEMPERATURE REACTIONS AND PHASE EQUILIBRIA IN THE STRONTIUM OXIDE–ZIRCONIUM OXIDE SYSTEM. Simmons, Wilbur Cameron. Columbus, Ohio, Ohio State Univ., 1968. 109p.

Thesis.

An investigation of the strontium oxide–zirconium oxide system by x-ray diffraction, differential thermal analysis, and thermogravimetric and metallographic analysis has lead to the construction of the equilibrium phase diagram. The diagram is characterized by two compounds. The compound $SrZrO_3$, strontium zirconate was found to be stable from 85°K to above 2000°C and its reported melting point is above 2600°C. There is a very limited solution range on the zirconia rich side (<1%) and on the strontia rich side (≈3%). The $Sr_3Zr_2O_7$ compound was found to be stable from room temperature to 2280°C where it decomposed in a peritectic reaction forming $SrZrO_3$ plus liquid. Pure zirconia was found to accept less than 0.5% SrO in solid solution up to 2050°C, above which 5% SrO was taken into cubic solid solution. Strontium zirconate, $SrZrO_3$, was found to be in equilibrium with monoclinic zirconia from room temperature to 1110°C, tetragonal zirconia from 1110 to 2080°C, and cubic zirconia from 2080°C to the eutectic at 2290°C. The eutectic composition was found to be near 27.5 mole % SrO. Compositions containing more than 50% SrO were found to be extremely sensitive to moisture in the atmosphere and special precautions were taken to prevent hydration. No evidence was found to support the presence of the two compounds $Sr_4Zr_3O_{10}$ and Sr_3ZrO_4 previously reported. A second eutectic in the system was found at 75% SrO and ~2180°C. Preferential vaporization of strontia was found to be a serious problem with strontia rich compositions on the surface of solid samples below 2000°C and throughout the body above 2000°C. Only the center core of the sample was used and the zirconium: strontium ratio was monitored throughout the investigation by x-ray fluorescence analysis. Strontium zirconate, $SrZrO_3$, is recommended for further consideration and investigation as a refractory material for aerospace and general applications. (Diss. Abstr.)

34115 SILICONATED PYROLYTIC GRAPHITE. PART 2. THE STATE OF SILICON PRESENT IN SILICONATED PYROLYTIC GRAPHITE. Yajima, Seishi; Hirai, Toshio (Tohoku Univ., Sendai). J. Mater. Sci., 4: 424-31(May 1969).

By x-ray diffraction, surface oxidation, x-ray microanalysis, electron diffraction, and electron microscopy, the state of silicon present in siliconated pyrolytic graphite was examined on several samples prepared under a variety of conditions. In the siliconated pyrolytic graphite prepared at deposition temperatures below 1730°C the greater part of the silicon occurred as β-SiC. It did not segregate in the cone boundaries but dispersed uniformly. It existed as flake-like single crystals, whose size increased with decreasing temperature. The (111) plane of β-SiC is parallel to the (001) planes of graphite. (auth) (UK)

34116 HIGH TEMPERATURE STUDIES OF URANIA IN A THERMAL GRADIENT. Fryxell, R. E.; Aitken, E. A. (General Electric Co., Cincinnati). Contract AT(40-1)-2847. J. Nucl. Mater., 30: 50-6(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

Studies of uranium dioxide subjected to a longitudinal temperature gradient in a sealed metal system have shown that if oxygen deficiency exists or is created in the UO_2, a composition gradient is formed with decreasing oxygen concentrations at increasing temperatures. Based on experiments covering the range 1300 to 2500°C, the oxygen migration is reversible and arrives at steady state conditions in less than six hours, with a heat of transport, Q*, of about 23 kcal/mole which is independent of the average oxygen deficiency and the atmosphere (hydrogen or argon). In a rhenium enclosed system which may be considered thermodynamically isolated, no measurable composition gradient can be formed in stoichiometric urania. (auth)

34117 EFFECT OF A TEMPERATURE GRADIENT ON THE STOICHIOMETRY OF URANIA–PLUTONIA FUEL. Evans, S. K.; Aitken, E. A.; Craig, C. N. (General Electric Co., Pleasanton, Calif.). J. Nucl. Mater., 30: 57-61(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

Refractory metal capsules containing $Pu_{0.2}U_{0.8}O_{2-x}$ pellets were subjected to thermal gradients in the temperature range 1200 to 2000°C. In each experiment a gradient in the oxygen-to-metal ratio was produced by migration of oxygen to the coldest region of the material. The highest temperature region was correspondingly deficient in oxygen. The data obtained were treated using the Arrhenius equation $\ln x = Q^*/(RT) + C$, where x is the deviation from stoichiometry, T is the absolute temperature and Q* is the heat of transport. (auth)

Radiation Effects

Refer also to abstracts 34037 and 34947.

34118 (GAMD-9015) MICA FOIL TECHNIQUE FOR DETERMINING FUEL PARTICLE COATING CONTAMINATION. Steward, K. P. (Gulf General Atomic, Inc., San Diego, Calif.). Mar. 20, 1969. Contract AT(04-3)-633. 44p. Dep. CFSTI.

A mica foil technique for revealing coating contamination in nuclear fuel particles has been developed. The technique is described together with problems encountered during development. The method has been applied to studies of uranium contamination in coatings on TRISO-I and TRISO-II particles, and in the PyC coatings of fuel production division (F.O.D.) TRISO-II fertile particles. The mica foil technique is a very sensitive method of determining uranium contaminations; results obtained using this method are in good agreement with values determined by other methods. Permanent photographic records of contamination in individual particles can be produced using the method and it is relatively fast, easy, inexpensive, and is the only sensitive way of comparing contamination and contamination distributions in different particles from the same batch, and of investigating contamination in individual particles. The coating contamination values for laboratory-produced TRISO particles show between 5×10^{-7} and 4×10^{-6} fraction ^{235}U in the outer PyC. LTI particles appear somewhat less contaminated than HTI, and TRISO-II particles are less contaminated than TRISO-I. Uranium contamination is present in all the F.O.D. fertile particles examined, and varies from about 0.01 ppM to 1.0 ppM in the outer PyC. Uniform concentrations of uranium in the outer PyC of fertile particles suggest the presence of uranium inside the coating furnaces, and higher uranium contaminations at the particle surfaces suggest uranium pickup outside the coating furnaces. (auth)

34119 FORMATION OF HELIUM DURING IRRADIATION OF C49-2 GLASS. Vekshinskii, S. A.; Pleshchenko, E. G.; Bekshinskaya, L. S. Dokl. Akad. Nauk SSSR, 185: 795-8(Apr. 1969). (In Russian).

The amount of helium separated from the glass irradiated by thermal neutrons was estimated and the influence of irradiation on the penetrability of glass was determined using c-49-2 (3S – 5K) glass irradiated by thermal neutron flux 1×10^{12} n/cm^2·sec). Data obtained showed that irradiation of electrovacuum device constructed with C49 – 2 glass or any ^{10}B-containing compound

destroyed the vacuum not only by incoming atmospheric helium but also by helium formed from neutron reaction with ^{10}B. (R.V.J)

34120 THE INFLUENCE OF BORON ON THE CLUSTERING OF RADIATION DAMAGE IN GRAPHITE. I. ELECTRON MICROSCOPIC OBSERVATIONS. Kelly, A.; Mayer, R. M. (Univ. of Cambridge, Eng.). Phil. Mag., 19: 701-20(Apr. 1969).

Graphite single crystals were doped with either ^{10}B or ^{11}B in the range 30 to 10^4 ppM. After irradiation to a dose of 7.6×10^{19} n/cm^2 at 650 or 900°C, the number and size of the interstitial loops were determined using thin foil electron microscopy. It was found that the loop density increased with the boron content to the one-half power and that the loop radius decreased with the boron content to the minus one-sixth power. The ^{10}B transmutation to lithium and helium has no influence on the nucleation of the interstitial loops. Different effects were observed upon annealing the irradiated crystals, depending on whether boron was introduced before or after irradiation. If the boron was introduced before irradiation, large vacancy loops were formed on annealing; if after irradiation, large interstitial loops were seen. The annealing results are interpreted on the basis of mutual annihilation between vacancies and interstitials and the loss of defects to the surface. (auth) (UK)

34121 THE INFLUENCE OF BORON ON THE CLUSTERING OF RADIATION DAMAGE IN GRAPHITE. II. NUCLEATION OF INTERSTITIAL LOOPS. Brown, L. M. (Univ. of Cambridge, Eng.); Kelly, A.; Mayer, R. M. Phil. Mag., 19: 721-42(Apr. 1969).

A model for describing the clustering of interstitial atoms in graphite is presented, based on chemical reaction rate theory. Vacancies and interstitials are assumed to be homogeneously generated by neutron flux. The interstitials are allowed to move freely between the layer planes, while the vacancies are considered to be stationary. Two types of nucleation are considered: (1) homogeneous nucleation when one unbound interstitial meets another unbound interstitial, (2) heterogeneous nucleation when one unbound interstitial encounters another interstitial atom bound already to a boron atom. It is shown that heterogeneous nucleation may be taken into account in the reaction rate theory by reducing the velocity of the interstitials by an amount which corresponds to the time they spend bound to an impurity. Differential equations are formulated to allow for the variation of loop density and average loop radius with time. Numerical and asymptotic solutions are obtained and fitted to data obtained from electron microscope observations. The theory predicts that the loop density is proportional to the square root of the impurity concentration and that the loop radius is inversely proportional to the sixth root of the impurity concentration, provided the interstitial velocity is impurity controlled. (auth) (UK)

34122 INFLUENCE OF BORON ON THE CLUSTERING OF RADIATION DAMAGE IN GRAPHITE. III. PHYSICAL PROPERTY MEASUREMENTS. Mayer, R. M. (National Physical Lab., Teddington, Eng.). Phil. Mag., 19: 743-56(Apr. 1969).

X-ray lattice parameters and electrical resistivity, magnetoresistivity and Hall coefficient were measured as a function of boron concentration in graphite single crystals. These measurements were consistent with boron forming a substitutional solid solution up to a concentration of 1% boron in graphite. The electronic property changes were correlated with the effect of addition of boron in solid solution to give an estimate of the defect concentration after irradiation to a dose of 7.6×10^{19} n/cm^2 (Ni) at 150, 650 or 900°C. X-ray diffraction examination of the crystals irradiated at 650°C showed that the Bragg reflections had both a diffuse and a sharp component, the intensity of the diffuse component increasing and of the sharp component decreasing with increasing boron content. The lattice parameter change, as measured by the shift in position of the sharp component of the reflection, was associated with vacancies, isolated or in small clusters, up to a boron concentration of 4×10^{-4}. (auth) (UK)

34123 STABILIZATION OF RADIATION DAMAGE BY RARE GAS ATOMS. Matzke, Hj. (CCR–EURATOM, Ispra, Italy). J. Nucl. Mater., 30: 107-9(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

The influence of high concentrations of both inert gas atoms and defects on the retardation of the release (trapping) of inert gas atoms in crystals was investigated. Single crystals of KCl were labeled with high and low doses of radioactive xenon ions. Some of the crystals had first been damaged by bombarding them with a very high dose of 2×10^{16} ions/cm^2 using beams of hydrogen, nitrogen, carbon monoxide, chlorine or indium. Trapping of xenon in KCl, most noticeable at high gas and high damage concentrations, is due to the presence of the gas that tends to stabilize defects, possibly due to gas-gas interactions as well as to gas-damage interactions. A high damage concentration alone, from prebombardments of the crystals, results in a much less pronounced retardation of the gas release. (G.M.C.)

34124 IRRADIATION BEHAVIOUR OF FISSION-GAS BUBBLES AND SINTERING PORES IN UO_2. Ross, A. M. (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Nucl. Mater., 30: 134-42(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

Replica electron microscopy of fracture surfaces was used to examine the stability towards irradiation of fission-gas bubbles and sintering pores in UO_2. The investigation was prompted by an unexpected lack of these in UO_2 fuels irradiated at temperatures <1500°C to burnups ≳6000 MWd/t U. Fission-gas bubbles grown by post-irradiation annealing at 1500°C were found to be unstable under a subsequent irradiation. Intragranular bubbles having diameters ≤0.1 μm were almost completely destroyed (or redistributed into smaller bubbles not discernible by replication) by irradiation at ≲200°C to 500 MWd/t U (1.4×10^{19} fissions/cm^3 UO_2). The larger intergranular bubbles were still present after irradiation; these, however, had apparently shrunk with the smaller bubbles showing the greater proportional decreases in volume. The closed pores initially present in sintered UO_2 showed a similar instability towards irradiation. An irradiation below 200°C to only 80 MWd/t U removed most of the pores of diameter ≤0.3 μm. After an irradiation of 400 MWd/t U the UO_2 fracture contours suggested a distorted structure. This was less marked after a higher exposure (800 MWd/t U), but more intergranular cracks were observed than after the lower exposures. The results account for the lack of fission-gas bubbles and fabrication pores in fuels of sintered UO_2, and can be explained by irradiation-induced sorption of gas atoms from gas-filled porosity in this material. (auth)

34125 ROLE OF BUBBLES IN FISSION GAS RELEASE FROM URANIUM DIOXIDE. Cornell, R. M.; Speight, M. V.; Masters, B. C. (Central Electricity Generating Board, Berkeley, Eng.). J. Nucl. Mater., 30: 170-8(Apr. 1969).

From Fundamental Properties of Materials and Nuclear Fuel Assemblies, Schenectady, N. Y. See CONF-680825.

Experimental evidence for the mechanisms of bubble mobility in irradiated UO_2 is reviewed. Examination of the bubble distribution in irradiated material shows that significant directed bubble motion does not occur. This result is confirmed by calculation, and it is also predicted that Brownian movement is an unimportant mode of release for burn-ups of practical interest. A description is made of the theory of transport of gas to the grain boundaries involving the irradiation re-solution of intra- and inter-granular bubbles. (auth)

Plastics and Other Materials

Refer to abstracts 33373, 34067, and 34896.

PHYSICS (GENERAL)

Astrophysics and Cosmology

34126 PROCEEDINGS OF THE ASTRONOMICAL SOCIETY OF AUSTRALIA. Second Annual General Meeting Held at the Australian National University, Canberra, on 29 and 30 November and 1 December 1967. Wild, J. P. (ed.). Proc. Astron. Soc. Aust., 1: 70-122(Feb. 1968). (CONF-671141).

A total of thirty-nine invited and contributed papers were presented on the Sun and solar system, stars, interstellar space, extra-galactic phenomena, radiation theory, x- and cosmic-ray astronomy, and instruments. Separate abstracts were prepared for 32 of the papers. (W.D.M.)

For abstracts of individual papers see: 34134–34145, 34160–34163, 34170–34175, 34208, 34238–34243, 34256, 34290, and 34291.

Cosmic Ray Exposure Ages

34127 CORRELATION BETWEEN FISSION TRACTS AND FISSION-TYPE XENON FROM AN EXTINCT RADIOACTIVITY. Wasserburg, G. J.; Huneke, J. C.; Burnett, D. S. (California Inst. of Tech., Pasadena). Phys. Rev. Lett., 22: 1198-1201 (June 2, 1969).

Meteoritic whitlockite containing excess fission tracks has a large concentration of excess neutron-rich xenon isotopes which is 25 times that calculated from the track density. The isotopic spectrum is identical to that calculated previously for the Pasamonte achondrite. These results uniquely associate this spectrum with in situ fission. Identification of the fissioning nucleus as ^{244}Pu gives $^{244}Pu/^{238}U \approx 1/_{30}$ at the time of xenon retention. Neither "sudden" nor "uniform" nucleosynthetic models give consistent solutions for $^{244}Pu/^{238}U$ and $^{235}U/^{238}U$. (auth)

34128 ^{26}Al IN METEORITES. VI. ACHONDRITES. Fuse, Kiyono; Anders, Edward (Univ. of Chicago). Geochim. Cosmochim. Acta, 33: 653-70(June 1969).

Cosmogenic ^{26}Al was measured by nondestructive $\gamma-\gamma$ coincidence counting in 21 achondrites and 6 chondrites. A weighted regression analysis of these and earlier data gave the following mean production rates of ^{26}Al, in dpm per kg of target element: Al 476 ± 54, Si 310 ± 10, S 38 ± 44. These figures are based on the following assumed or calculated production rates: Mg 0, Ca 7, (Fe + Ni) 2.2 dpm/kg. Five additional sets of production rates were calculated on the basis of various alternative assumptions. Fifteen of the meteorites had ^{26}Al contents more than two standard deviations below the mean saturation value; three of these low values were due to short radiation ages, and most of the remaining to shielding. Ureilites and diogenites, in particular, tend to have abnormally low ^{26}Al contents. A review of ^{26}Al data for chondrites shows that values determined by nondestructive $\gamma-\gamma$ coincidence counting show little dispersion; only 11 of 71 cases differ by more than ±15% from the calculated saturation value. The mean ^{26}Al content is 0.94 of saturation value, and shows virtually no dependence on recovered mass in the range 1 to 700 kg. Measurements by other methods often are substantially lower, apparently due to systematic errors. The eucrite Serra de Magé has an ^{26}Al age of 0.065 ± 0.018 m.y., very much shorter than its ^{3}He, ^{21}Ne, ^{38}Ar age of 1.9 m.y. Apparently it has suffered a two-stage irradiation; first for ≥32 m.y. shielded by 1.5 to 5 m of overlying material, and then for ≤0.10 m.y. as an unshielded, decimeter-sized fragment. A similar history is indicated for the Cl chondrite Ivuna. (auth) (UK)

Stars

Refer also to abstract 34243.

34129 STUDIES OF COOL STARS IN THE ONE-MICRON REGION. Lockwood, George Wesley. Charlottesville, Va., Univ. of Virginia, 1968. 129p.

Thesis.

Infrared image-tube spectra of a number of late-type stars have been obtained with the cassegrain spectrograph and 32-inch reflecting telescope of the Leander McCormick Observatory. The wavelength interval, 7900 to 12,000 Å, was surveyed at a reciprocal linear dispersion of 45 Å/mm. The initial goals of the survey were (1) to study differences in infrared stellar spectra as a function of spectral class, and the changes in the spectra of long-period variables with phase, and (2) to search for indicators of stellar water vapor in the 1.1 μ region. A description of the image-tube camera is given. Eleven spectrograms of K and M giants, and the Mira variable, R Leo (spectrum: M7e), λλ9600 to 11,000 Å, were reduced by conventional methods. Wavelengths were determined with an accuracy of about 1 Å. Only a few strong atomic line multiplets could be identified with certainty: Ti(31), Ti(32), Sr II (2), Fe(59), Si(5), and Si(6). Somewhat weaker, but probably present, also, were Ti(95), Ti(149), Cr(118), Fe(264), and Fe(1247). A number of other multiplets were tentatively identified. The Paschen hydrogen lines, Pγ and Pδ, were observed in emission in some variables near and after maximum light. (TSS) (Disser. Abstr.)

34130 HORIZONTAL-BRANCH STAR MODELS. Castellani, V. (Laboratorio di Astrofisica, Frascati, Italy); Giannone, P.; Renzini, A. Astrophys. Space Sci., 4: 103-18(May 1969).

Evolutionary tracks of 0.9 $M_\odot$, 0.7 $M_\odot$, and 0.6 $M_\odot$ models for Population II stars were computed in the post-red giant phase. The stars are initially composed of a helium core containing a mass fraction equal to 0.9 and of a hydrogen-rich envelope. They represent hypothetical remnants of stars after substantial mass loss in previous evolutionary phases or/and at the helium flash. (auth)

34131 CONVECTION IN NORMAL STARS AND METAL-DEFICIENT STARS. Krishna Swamy, K. S. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. Space Sci., 3: 552-63(Apr. 1969).

The depths at which convection starts were calculated for main-sequence stars and giant stars of various effective temperatures and hydrogen-to-metal ratios. It was found that for late-type stars of $T_e \gtrsim 4400$ K convection starts at $\tau \gtrsim 0.1$. In metal-deficient stars convection starts at shallower optical depths compared to normal stars of the same spectral type. The larger the metal deficiency, the shallower is the depth at which convection starts. The importance of convection in the study of metal-deficient stars and late type stars is also discussed. (auth)

34132 HEAVY-ELEMENT ABUNDANCES IN PECULIAR A STARS. Guthrie, B. N. G. (Royal Observatory, Edinburgh). Astrophys. Space Sci., 3: 542-51(Apr. 1969).

On the theory that peculiar A stars were once secondaries in binary systems in which the primaries exploded as type II supernovae, the nucleosynthesis during the final stages of evolution of massive stars is investigated. For heavy elements ($Z > 30$) the observed abundances in peculiar A stars reflect the composition of material ejected by the exploding primaries. Peculiar A stars are divided into two groups, the main group and the Mn group, and abundances in each group are summarized. During the explosions of the primaries, rapid (n,γ) or (γ,n) reactions operate on the abundance peaks previously formed by the s-process during the giant phase. In the main group primaries (n,γ) reactions predominate, and rare-earths are formed from the Ba peak. In the Mn group primaries (γ,n) reactions operate on the Sr, Ba, and Pb peaks to form Kr, Xe, and Hg. (auth)

34133 AN INVESTIGATION ON H-R DIAGRAMS OF GLOBULAR CLUSTERS. Castellani, V. (Laboratorio di Astrofisica, Rome); Giannone, P.; Renzini, A. Astrophys. Space Sci., 3: 518-29(Apr. 1969).

The most characteristic features of H–R diagrams of globular clusters are summarized with particular regard to the position and the extension of the horizontal branch. A comparison of observations with theory in the two cases of evolution with and without mass loss is given. A preliminary approach to the evolution of models with large mass fractions (q_0) in the helium cores is presented. Inhomogeneous equilibrium models with double energy sources were computed in a range of values of q_0 and of the total mass referring to possible horizontal-branch stars. (auth)

34134 THEOREM ON RAY TRAJECTORIES. Westfold, K. C. (Monash Univ., Melbourne). Proc. Astron. Soc. Aust., 1: 107-8(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

The classical theorems on the intensity of radiation depend on the geometry of rectilinear ray trajectories in uniform media. In particular, the theorem concerning the specific intensity I in a medium specified by an isotropic refractive index μ—that, where there are no gains due to emission or losses due to absorption or scattering, the quantity I/μ^2 = constant—is proved by assuming that the medium consists of a series of constant refractive index at whose plane interfaces the coefficients of reflection are zero. For these the geometry of the trajectories is such that, by Snell's law, $\mu^2 dS' d\Omega' = \mu^2 dS d\Omega$; then the conservation of

radiant energy requires that $I'dS'd\Omega' = IdSd\Omega$, whence the theorem is proved. In this note the geometrical result is proved for the first equation for a medium specified more generally by a continuously varying isotropic refractive index $\mu(x)$. (W.D.M.)

34135 A COMPARISON OF RADIO AND OPTICAL OBSERVATIONS OF THE 30 DORADUS NEBULA. Le Marne, A. E. (Univ. of Sydney). Proc. Astron. Soc. Aust., 1: 97-8(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

The Sydney University one-mile cross-type radio telescope at the Molonglo Radio Observatory was used to study the 30 Doradus nebula with high resolution (~3'arc) at 408 MHz. These observations are compared with Balmer line isophotes published by Faulkner (1967). (W.D.M.)

34136 VELOCITY VARIATIONS IN BETA CENTAURI. Shobbrook, R. R.; Robertson, J. W. (Univ. of Sydney). Proc. Astron. Soc. Aust., 1: 82-3(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

A total of 22 spectra of β Cen were obtained on the 74-inch Mount Stromlo coudé spectrograph on July 2, 4, 5, and 6, 1967, at a dispersion of 10 Å/mm. The short period, long period, and a model for β Cen are discussed. (W.D.M.)

34137 INFRARED OBSERVATIONS OF GLOBULAR CLUSTER GIANTS. Brooke, A. L. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust., 1: 83-4(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

A progress report is presented on a program of infrared photoelectric photometry of the red giant sequences in some southern globular clusters. Observations on the V, R, I system of Johnson were made of 30 stars in NGC 6397, 33 in ω Cen, and 27 in 47 Tuc, and 9 stars were observed in the old galactic cluster M67. All stars were observed on at least two separate occasions. (W.D.M.)

34138 THE MANGANESE STAR HD 1909. Buscombe, W.; Chambliss, C. R.; Kennedy, Pamela M. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust., 1: 84-5(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

A coudé spectrogram of dispersion 150 μ/Å, exposed at the 74-inch reflector by Mathewson, revealed very many unusually sharp absorption lines due to ionized metals in the atmosphere of the B9 star HD 1909. This spectrogram is discussed and some conclusions drawn from it are given. (W.D.M.)

34139 APPARENT SIZE OF RAPIDLY ROTATING STARS. Johnston, I. D.; Wareing, N. C. (Univ. of Sydney). Proc. Astron. Soc. Aust., 1: 85-6(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

Results were calculated for early main-sequence stars, rotating at typical speeds, viewed from three extreme orientations: (a) pole on; (b) equator on, with the axis of rotation parallel to the baseline of the interferometer; and (c) equator on, with the rotation axis perpendicular to the baseline of the interferometer. It was then possible to compare these rotating stars with typical main-sequence stars which are not rotating. (W.D.M.)

34140 RELATIVISTIC STELLAR DYNAMICS IN ROTATING AXIALLY SYMMETRIC SYSTEMS. Fackerell, E. D. (Monash Univ., Melbourne). Proc. Astron. Soc. Aust., 1: 86-7(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

Recently the possibility has been raised of using general relativistic star clusters as models for quasi-stellar sources. The theory of static, spherically symmetric, collisionless star clusters has been developed within the framework of general relativity. In particular, analogues have been found of the Newtonian polytropic models and of Woolley's truncated Maxwellian systems. However, in view of the importance of rotation on stability in relativistic astrophysical problems, it was thought to be of considerable interest to include the effect of rotation in relativistic stellar dynamics. (W.D.M.)

34141 FINITE-AMPLITUDE ADIABATIC OSCILLATIONS OF SUPER-MASSIVE STARS. van der Borght, R. (Monash Univ., Melbourne). Proc. Astron. Soc. Aust., 1: 87-8(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

As shown recently by Osaki, super-massive stars with mass $M < 3.5 \times 10^5\ M_\odot$ can, in the absence of rotation, reach the hydrogen-burning main sequence before the onset of general relativistic instability. Such objects are then pulsationally unstable. A considerable simplification is introduced if only very massive stars are considered, for which the relative amplitude of the fundamental mode of oscillation is practically constant. This sets a lower limit of $10^4\ M_\odot$ to the mass that can be considered. The upper limit is also reduced to $2 \times 10^5\ M_\odot$ if the relativistic correction is neglected. One necessary step in the study of nonlinear oscillations of massive stars is to derive a differential equation for the adiabatic pulsations. A method is given for taking into account the relativistic correction. (W.D.M.)

34142 ANHARMONIC OSCILLATIONS OF MASSIVE STARS. Murphy, J. O. (Monash Univ., Melbourne). Proc. Astron. Soc. Aust., 1: 88-9(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

It was the purpose of this investigation to determine the effect of any coupling between modes, through the nonlinear terms, which may limit the amplitude of the oscillation. Two cases were considered, M = 10 and M = 30. The results show that coupling through nonlinear terms does initially modify the form of the oscillations. (W.D.M.)

34143 MAGNETIC FIELDS IN SLOWLY ROTATING STARS. Davies, G. F. (Monash Univ., Melbourne). Proc. Astron. Soc. Aust., 1: 89(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

A magnetic field tends to upset thermal equilibrium and produce meridional circulation. In the absence of rotation, an equilibrium poloidal field has recently been found for which there is no circulation. The present paper reports analogous equilibrium solutions for a star which is in uniform rotation. (W.D.M.)

34144 NEUTRINO–ELECTRON INTERACTIONS AND STELLAR EVOLUTION. Campbell, J. A. (Flinders Univ., Bedford Park, South Australia). Proc. Astron. Soc. Aust., 1: 89-91(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

A large part of the energy lost from interiors of evolving stars at temperatures greater than about 5×10^8 K is carried away by neutrinos. Four neutrino-producing reactions which have been incorporated into various evolutionary models are discussed and the astrophysics and particle physics implications of these reactions are reviewed. (W.D.M.)

34145 EVOLUTION OF HELIUM SHELL-BURNING STARS. Faulkner, D. J. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust., 1: 91-2(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

Divine (1965) and L'Ecuyer (1966) considered planetary-nebulae stars in which helium is still burning in a shell. Tracks computed by these authors for 0.7 $M_\odot$ and 1.0 $M_\odot$ stars are shown on a H–R diagram. The present investigation extends this work on helium shell-burning stars. Evolutionary sequences were obtained, using the Henyey method, for stars of mass 0.8 $M_\odot$, 0.9 $M_\odot$, and 1.0 $M_\odot$. (W.D.M.)

34146 THE f-NUMBERS OF Fe III. Baker, S. C. (Univ. of Newcastle, New South Wales). Proc. Astron. Soc. Aust., 1: 158-9(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

Lines of Fe III are prominent in the spectra of hot stars and the f numbers of some 425 lines have been calculated, but it appears that no experimental measurements have been made. An attempt to measure some of the f numbers for Fe III is described. (W.D.M.)

34147 NUMERICAL EXPERIMENTAL CHECK OF LYNDEN-BELL STATISTICS FOR A COLLISIONLESS ONE-DIMENSIONAL STELLAR SYSTEM. Goldstein, Shyke (Tel-Aviv Univ., Israel); Cuperman, Sami; Lecar, Myron. Mon. Notic. Roy. Astron. Soc., 143: 209-21(1969).

Lynden-Bell's statistical mechanics of violent relaxation in stellar systems was checked by numerical experiments on one-dimensional collisionless self-gravitating systems. All the free parameters of the statistics (the initial fine grained phase space density, the total energy and the total mass) were kept constant, while the configuration in phase space was varied. Three cases reached the same final state. In all three cases the distribution of the low-energy particles (about 60% of the particles) resembled Lynden-Bell's prediction, but the high-energy tail containing the bulk of the total energy was not in accord with the statistics. It is not known what fraction of the tail was formed dynamically or was left behind from the initial distribution and failed to interact with the bulk of the particles. (auth)

34148 STAR FORMATION IN CLOUDS OF SOLID HYDROGEN GRAINS. Reddish, V. C. (Royal Observatory, Edinburgh); Wickramasinghe, N. C. Mon. Notic. Roy. Astron. Soc., 143: 189-208(1969).

It is shown that the condensation of hydrogen on to interstellar grains produces a cellular pressure structure in interstellar clouds leading to fragmentation and star formation. The masses of the stars depend on both the gas density and grain abundance. These quantities are calculated for models beginning with a low density and low grain abundance, and in which more grains are produced in late-type stars from carbon synthesized in earlier stellar generations. It is found that, in all cases, supermassive objects are formed first. As the density and opacity of the interstellar clouds increase, the masses of the objects decline. As they pass through the mass range of supernovae, there is an outburst of heavy element production followed by the formation of large numbers of dwarf stars over a prolonged period of time. By that time the helium abundance has reached several per cent. Present values of heavy element and grain abundances are obtained if the mass ejected by supernovae contains on average 4.4% heavy elements, and if 23% of the carbon in late-type stars is ejected in the form of graphite grains. The heavy element abundance averaged over all stars is about a fifth of the solar value. (auth) (UK)

34149 OBSERVATION OF PROLONGED RADIO EMISSION FROM A RED DWARF STAR. Lovell, Bernard (Univ. of Manchester, Jodrell Bank, Eng.). Nature (London), 222: 1126-9 (June 21, 1969).

A remarkable outburst from a red dwarf flare star (YZ Canis Minoris) was observed by radio and optical telescopes. An account is given of the radio observations. (auth) (UK)

34150 LARGE FLARE ON YZ CANIS MINORIS. Kunkel, William E. (Cerro Tololo Interamerican Observatory, La Serena, Chile). Nature (London), 222: 1129-30(June 21, 1969).

Visual and photoelectric recordings of the outburst from the star YZ Canis Minoris, reported from the Cerro Tololo Interamerican Observatory, are described. (auth) (UK)

34151 OUTER LAYERS OF THE RED DWARF STAR YZ CMi. Kahn, F. D. (Univ. of Manchester, Eng.). Nature (London), 222: 1130-2(June 21, 1969).

The structure of the corona around YZ Canis Minoris, based on the observations by Lovell and Kunkel is discussed. (auth) (UK)

34152 SYNTHESIS OF THE ELEMENTS WITHIN OBJECTS EXPLODING FROM VERY HIGH TEMPERATURES. Wagoner, Robert V. (California Inst. of Tech., Pasadena). Contract Nonr-220(47). Astrophys. J., 18: Suppl. Ser., 162, 247-95(June 1969).

A general method is presented for computing the abundances produced by objects which explode from states of very high temperatures. The nuclear evolution of nondegenerate matter expanding from temperatures of at least 10^{10}K is studied in detail for various values of the expansion rate and of the proton–neutron abundance difference and baryon density at 10^{10}K. These three parameters are the only factors that can influence element production under the conditions considered. Definite abundance predictions are made for each of the lighter nuclei ($A \leq 27$) plus the sum of all others ($A \geq 28$), but only individual volume elements within the object are considered. It is found that a range of models characterized by initial proton–neutron equality (mass-fraction differences $<10^{-3}$) and expansion rates faster than $\sim 10^4$ times the "gravitational" rate $\sqrt{(24\pi G\rho)}$ can produce abundances that are in rough agreement with those observed in the most metal-weak stars in the Galaxy, if they contain appreciable helium. These same models produce abundances of ^{7}Li, ^{9}Be, ^{10}B, and ^{11}B which are much closer to solar-system values, however, making the observation of these elements in old stars a possible test for the occurrence of violent events early in the history of the Galaxy. Detailed comparisons with observation, however, must await more measurements of both the cross sections of many critical reactions and the element abundances especially in the oldest stars and quasi-stellar objects. Apart from the question of whether the particular models considered are realized in nature, the general process appears to be promising as a method of synthesis, since the ratios among many of the elements and isotopes produced are close to those observed in the solar system. The major characteristic of this process, which makes possible the simultaneous synthesis of all stable nuclei (with the exception of ^{6}Li) in the mass range considered, is the high abundance of neutrons, protons, and α particles throughout. The very fast expansion rates and initial proton–neutron equality are necessary to guarantee continued proton–neutron equality, keeping the synthesis routes near the β-stability line. (auth)

34153 CHEMICAL COMPOSITION AND EVOLUTION OF Ap AND Am STARS. Hack, Margherita (Osservatorio di Trieste, Italy). Arch. Sci. (Geneva), 21: 165-70(May-June 1968). (In French).

The properties of Ap and Am stars are recalled; they are placed near the main sequence. The coldest Ap stars are 0.5 to 0.75 magnitudes above the main sequence after blanketing correction; the Am stars are similarly a bit to the left of the sequence. There are arguments in favor of their being slow rotators, including the v sin i distribution and duplicity. Spectroscopic details interpretable as chemical anomalies are: O is usually deficient, as are Mg, Ca, and Sc; Si is normal, as are Ti, Cr, and Mn; Sr and the rare earths are in excess. Exceptions to these generalizations are tabulated. The anomalies may be explained by several arguments; these stars may not be evolved stars, and their plane with the observer may be one in which convective current to the surface is observed, with a slow speed of rotation; or they may be nonevolved, with a strong variable magnetic field favoring nuclear reactions in the atmosphere; they may be evolved, and have passed through the red giant phase and are passing through the principal sequence; or they may be part of a dwarf binary system. The evolutionary process of these stars is not clear. (BBB)

34154 THE EFFECTS OF THE ROTATION OF STARS IN DIAGRAMS OF MULTICOLOR PHOTOMETRY. Golay, M. (Observatoire de Geneve). Arch. Sci. (Geneva), 21: 105-24(May-June 1968). (In French).

The 7-color photometry of the Geneva Observatory allows the determination of parameters of spectral type, luminosity, metallicity, and binarity; it has been used for the study of photometric effects of the rotation of stars. A characteristic parameter for the rotation of hot stars is defined and used to determine the speeds of rotation of stars contained in the spectral types B_0 to B_3. The photometric effect of rotation on color indexes and absolute magnitude is studied for the spectral types B_0 to F_7. The importance of the photometric effects varies with the spectral type. The results obtained for hot stars are twice as large as those theoretically predicted; stars in the A_0-A_7 categories fit the uniformly rotating "gray atmosphere" models; stars colder than F_0 follow the nonuniform rotation model for slow rotation. (BBB)

34155 BRACKETT-ALPHA EMISSION IN NON-LTE MODEL STELLAR ATMOSPHERES. Auer, L. H. (Yale Univ. Observatory, New Haven); Mihalas, Dimitri. Astrophys. J., 156: L151-3 (June 1969).

Recent computations of non-LTE model stellar atmospheres predict the appearance of Brackett-α (Bα) in emission. This line at 4.05 μ lies in a window of the absorption spectrum of the terrestrial atmosphere and should be observed as a test of of this theoretical prediction. (auth)

34156 POSSIBLE MECHANISM FOR ENERGIZATION OF STELLAR WINDS IN EARLY-TYPE STARS. Mihalas, Dimitri (Yerkes Observatory, Chicago). Astrophys. J., 156: L155-8 (June 1969).

Expanding envelopes observed in early-type supergiants (and other related stars) are suggested to be stellar winds energized by the mechanical-energy flux produced in a Rayleigh–Taylor instability zone in the photospheres of these stars. (auth)

34157 THERMAL CONDUCTION BY ELECTRONS IN STELLAR MATTER. Hubbard, W. B. (California Inst. of Tech., Pasadena); Lampe, Martin. Astrophys. J., 18: Suppl. Ser. 163, 297-346(June 1969).

Tables of electron-conduction opacity are presented which incorporate recent advances in the theory of electron conduction in stellar matter. The following effects are included: (a) electron–ion and electron–electron collisions; (b) electron–electron, electron–ion, and ion–ion correlations and shielding; (c) correct treatment of the low-temperature low-density regime where the Born approximation fails. A calculation of electron thermal conductivity in the ion solid state is presented. Relativistic effects are not included. Tables are presented for hydrogen, helium, carbon, composition of red-giant cores, and solar composition over a range of density from $10^{-5.75}$ to 10^6 g cm^{-3}, and a range of temperature from 10^3 to 10^9°K. Regions where the theory breaks down are excluded. In the case of hydrogen and helium it was found that electron–electron collisions may decrease the thermal conductivity significantly even for relatively high degeneracy. For a typical red-giant core, it was found that the conductive opacity is 2 to 3 times larger than currently accepted values. (auth)

34158 LARGE OPTICAL POLARIZATION OF THE OH EMISSION SOURCE VY CANIS MAJORIS. Serkowski, K. (Australian National Univ., Canberra). Astrophys. J., 156: L139-40(June 1969).

Polarization of 18% was observed in the ultraviolet spectral region of VY Canis Majoris. The percentage polarization and the position angle are linear functions of frequency in the spectral regions from the ultraviolet to the yellow. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 33566, 34211, 34322, and 34596.

34159 GENERATION OF RADIO WAVES IN ASTROPHYSICAL PLASMAS. Smerd, S. F. (Commonwealth Scientific and Industrial Research Organization, Sydney). Proc. Astron. Soc. Aust., 1: 124-9(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

The observed intensity of radiation at a given frequency and wave mode is determined by the equation $I = \int_0^m (\eta \cos\theta/\mu^2\varkappa)e^{-\tau}d\tau$, where $\tau = \int \varkappa ds$ is the optical depth, $\varkappa$ is the linear absorption coefficient, μ the real refractive index, and η the volume emissivity. The angle θ is the angle between the Poynting vector and k, the propagation vector. Two of these macroscopic radiation coefficients, μ and $\varkappa$ may be combined in the complex refractive index $n = kc/\omega$ where $n = \mu + i\chi$, the latter quantity being related to $\varkappa$ throng $\varkappa = 2\omega\chi \cos\theta/c$. In general circumstances the determination of n and η may be extremely complicated. An attempt is made to summarize and sort out the work which has been done to elucidate these quantities. (W.D.M.)

34160 MASER ACTION IN INTERSTELLAR OH. Robinson, B. J. (Commonwealth Scientific and Industrial Research Organization, Sydney). Proc. Astron. Soc. Aust., 1: 70-3(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

The most plausible hypothesis for 18-cm emission from OH is that of naturally occurring interstellar gas masers. Some of the latest evidence in favor of maser action is given, and where the evidence is inadequate is indicated. Attention is focused on work done in 1967. (W.D.M.)

34161 THE VARIABILITY OF CENTAURUS XR-2. Francey, R. J. (Univ. of Tasmania, Hobart); Fenton, A. G.; Harries, J. R.; McCracken, K. G. Proc. Astron. Soc. Aust., 1: 108-9(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

This note presents results from a series of rocket flights that have yielded the first unambiguous evidence for the variability of a cosmic x-ray source. The evidence rests primarily on three rocket flights, two from Woomera and one from Hawaii. Results from the flights are summarized. (W.D.M.)

34162 THERMAL MODELS OF CENTAURUS XR-2. Edwards, P. J.; Harries, J. R. (Univ. of Adelaide). Proc. Astron. Soc. Aust., 1: 109-11(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

Recent observations of the Centaurus region have firmly established the existence of a variable x-ray source, Cen XR-2. Two possible models for this source are considered, black-body models and the thin-plasma model. (W.D.M.)

34163 THE X-RAY ALBEDO FROM THE EARTH. Harries, J. R. (Univ. of Adelaide); Francey, R. J. Proc. Astron. Soc. Aust., 1: 111-12(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

An albedo x-ray flux from the Earth was observed by experiments flown on Skylark rockets during April 1967. The details of the flights and the equipment have been covered previously. The average count rate observed on four or five scans which passed near to the zenith are shown. The processes leading to this albedo are discussed. (W.D.M.)

34164 LOW FREQUENCY OBSERVATIONS OF EMISSION NEBULAE AND THEIR ELECTRON TEMPERATURES. Terzian, Yervant (Cornell Univ., Ithaca, N. Y.). Astrophys. Space Sci., 3: 479-89(Apr. 1969).

Radio observations of emission nebulae at 74 MHz are reported. Flux densities for NGC 1499, IC 405, IC 410, NGC 2024, NGC 2175, NGC 2237-46, and NGC 6820 are given. Most of the observed nebulae are found to be optically thick at 74 MHz. Combining the low-frequency results with previously measured flux densities at high frequencies, it is shown that it is possible to derive the mean electron temperatures of the observed nebulae. The results show that the range in temperature is from 3200 to 6800 K. (auth)

34165 CORRELATION BETWEEN THE DENSITIES OF X-RAY SOURCES AND INTERSTELLAR GAS. Fujimoto, M.; Hayakawa, S.; Kato, T. (Nagoya Univ., Japan). Astrophys. Space Sci., 4: 64-83(May 1969).

The distribution of x-ray sources in the Galaxy is obtained, assuming that the absolute x-ray luminosities of these sources are the same. The distribution is found to be in good correlation with the distribution of interstellar gas. The density of x-ray sources is nearly proportional to the square density of gas. This indicates that x-ray sources are comparatively young. The relation between the densities of x-ray sources and gas allows one to estimate the x-ray intensities of various objects such as Magellanic Clouds and Andromeda Nebula, and also to obtain the average x-ray luminosity of spiral galaxies. The latter should increase as the age of a galaxy decreases, since the amount of gas decreases as the galaxy evolves. Under the assumptions that the gas density is inversely proportional to the age and that galaxies older than $t_0/30$ are visible in x rays, where t_0 is the present age of the Universe, the contribution of x-ray sources in distant galaxies to the background component is calculated. The intensity and the spectrum of the background component of x rays thus obtained are in fair agreement with observed ones in the energy range between 1 and 4 keV but significantly deviate from the latter at high energies. (auth)

34166 MEASUREMENT OF THE ABSOLUTE INTENSITY OF COSMIC X RAYS. Matsuoka, M. (Tokyo Univ.); Oda, M.; Ogawara, Y.; Hayakawa, S.; Kato, T. Astrophys. Space Sci., 4: 44-63(May 1969).

The intensity of the diffuse component of cosmic x rays was measured with use of a rotating collimator system borne on a sounding rocket. A part of the background counts proportional to the field of view of the proportional counters led to the intensity of the diffuse component 0.66 ± 0.07 photons cm^{-2} sec^{-1} sr^{-1} keV^{-1} in the energy range between 3.6 and 9.0 keV. The spectrum in this energy range was found to be comparatively flat. The intensity of Sco X-1 was also measured and its time variation was investigated. (auth)

34167 JUPITER MODEL OF PULSARS. Dowden, R. L. (Univ. of Otago, New Zealand). Proc. Astron. Soc. Aust., 1: 159(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

The purpose of this paper is to compare the received power from a pulsar with what might be expected if the radiation process (cyclotron) is similar to that for Jupiter. The model outlined is generally less extreme than many suggested in recent papers in Nature. (W.D.M.)

34168 X-RAY ASTRONOMY: 1968 VINTAGE. Webber, W. R. (Univ. of Adelaide). Proc. Astron. Soc. Aust., 1: 160-4 (Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

The mechanisms for production of x rays are briefly outlined. Very simply, the emission of x rays on an astrophysical scale is related to the presence of energetic electrons. The mechanisms whereby the electron energy is transformed into x-ray photons are synchrotron emission, inverse Compton effect, and free–free emission. The characteristics of the observed x-ray sources and background emission are discussed in some detail. (W.D.M.)

34169 THE DETECTION OF HIGH-ENERGY X-RAYS FROM ARA XR-1 AND NOR XR-1. Thomas, R. M. (Univ. of Adelaide). Proc. Astron. Soc. Aust., 1: 165-6(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

This paper presents observations of weak x-ray sources at photon energies between 20 and 100 keV made during a balloon flight from Mildura on Feb. 29, 1968. The detector used was an actively collimated and shielded NaI(Tl) crystal, 2 mm thick and 54.3 cm^2 in area. The sources from which significant hard x-ray fluxes were observed for the first time were Ara XR-1 and Nor XR-1. (W.D.M.)

34170 THE INVERSE COMPTON EFFECT IN EXTRAGALACTIC RADIO SOURCES. Johnston, I. D.; Rothman, G. P. (Univ. of Sydney). Proc. Astron. Soc. Aust., 1: 105-6(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

It is proposed to construct a quasar model which will include inverse Compton scattering, but will not predict the high flux of hard γ rays. The essential assumption in this model is that the core of the quasar has not only a high radiation density, but also a high plasma density; so that each γ ray emitted in the inverse Compton encounters, will also suffer many ordinary Compton collisions, so that the energy of the quasar does not escape except by photons of greatly degraded frequency. (W.D.M.)

34171 A NOTE ON SOME 4C RIGHT ASCENSIONS. Clarke, T. W.; Munro, R. E. B. (Univ. of Sydney). Proc. Astron. Soc. Aust., 1: 98-9(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

The Molonglo fan-beam survey covered the region in right ascension from 10 h 30 m to 18 h 30 m and in declination from +18° to −40°. The region common to the 4C survey was analyzed and right ascensions were obtained for the 4C sources. (W.D.M.)

34172 A SUMMARY OF RECENT OBSERVATIONS WITH THE PARKES INTERFEROMETER. Wall, J. V. (Australian National Univ., Canberra); Cole, D. J.; Milne, D. K. Proc. Astron. Soc. Aust., 1: 98(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

The present series of observations consists of determining visibility functions for all Parkes catalog sources of intensity >1 f.u. at 2700 MHz in the declination zone 0 to −33°. Visibility functions on both the E−W and N−S tracks have been obtained at transit for all the 275 sources thus selected, and tentative structural information is available. (W.D.M.)

34173 FAN-BEAM OBSERVATIONS OF BRIGHT GALAXIES. Cameron, M. J.; Glanfield, J. R. (Univ. of Sydney). Proc. Astron. Soc. Aust., 1: 102-4(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

A survey was made of 139 bright southern galaxies using the 1.5′ × 4° fan beam of the E−W arm of the Mills cross. These represent a largely complete sample of galaxies down to a limiting total optical magnitude of ~11.0 when corrected for galactic absorption by 0.35 cosec β and for internal absorption due to the tilt of the emitting galaxy. The galaxies were examined for correlations between radio and optical properties such as dependence on galaxy type on the Hubble and Morgan classifications. (W.D.M.)

34174 RADIO OBSERVATIONS OF SEVEN SUGGESTED SUPERNOVA REMNANTS. Milne, D. K. (Commonwealth Scientific and Industrial Research Organization, Sydney). Proc. Astron. Soc. Aust., 1: 93-4(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

Recently Aizu and Tabara (1967) listed 36 radio sources classified as SNR. Some of the identifications were based on low-resolution radio data and were consequently unreliable. Using the Parkes 210-foot telescope at 635, 1410, and 2650 MHz, seven of these sources were observed. Of these seven, there was close agreement with Aizu and Tabara's data only in one case (3C 396.1), and the author agrees with the SNR classification, with certain reservations, for only three of the sources. (W.D.M.)

34175 COSMIC NOISE INTENSITIES AT HECTOMETRE WAVELENGTHS. Parthasarathy, R. (Univ. of Alaska, College). Proc. Astron. Soc. Aust., 1: 94-6(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

The object of this investigation was to determine the galactic background intensity at 2 and 3 MHz. The observation is an extension of earlier work in which the noise temperatures at 50, 30, 20, 10, and 5 MHz were obtained at 65°N declination by means of identical antennas of beam width 70° between half-power points. The temperatures were obtained separately in the ordinary and extraordinary modes, in order to account for the attenuation in the ionosphere. (W.D.M.)

34176 OBSERVATIONS OF HIGH-ENERGY X-RAYS FROM SAGITTARIUS. Clancy, M. C. (Univ. of Adelaide). Proc. Astron. Soc. Aust., 1: 166-8(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

During a recent balloon flight from Mildura, the region of the Galaxy between $-10° < l^{II} < +20°$; $-5° < b^{II} < +5°$ was surveyed for high-energy x rays of energy >17 keV. The narrow opening angle of the telescope enabled two sources to be resolved in this region of the sky. The position of one of these sources agreed with the source GX3 + 1 while the other source was probably GX −5.6. Improved positional information for the latter source is presented and is designated GX 354-5. (W.D.M.)

34177 THE OBSERVATION OF X-RAYS FROM THE GALACTIC CENTRE AND CENTAURUS REGIONS. Buselli, G. (Univ. of Adelaide). Proc. Astron. Soc. Aust., 1: 168-9(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

This paper reports results from a graded-shield x-ray telescope experiment flown from Mildura on Feb 29, 1968. The main regions of interest were the Scorpius, Sagittarius, and Centaurus regions of the sky. Spectra are given for Sco X-1, GX3 + 1, Sgr X − 1, and Cen X − 2. (W.D.M.)

34178 THE X-RAY SPECTRUM OF SCO XR-1 TO 100 keV. Davison, P. J. N. (Univ. of Adelaide). Proc. Astron. Soc. Aust., 1: 169-71(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

This paper presents the results of a measurement of the high-energy ($E \geq 17$ keV) x-ray flux from Sco XR-1 extending to higher energies than has previously been reported. The measurement was made during a balloon flight launched from Mildura, on Feb. 29, 1968. The corrected spectrum is given. (W.D.M.)

34179 A MEASUREMENT OF THE DIFFUSE COSMIC X-RAY BACKGROUND FROM 17 TO 167 keV. Thomas, R. M. (Univ. of Adelaide). Proc. Astron. Soc. Aust., 1: 171-2(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

This paper presents a measurement of the diffuse cosmic x-ray background made during a balloon flight from Mildura. The data used were obtained with an actively shielded and collimated detector. The geometric factor of the detector was 1.17 cm^2 sterad. The possibility of an anisotropy in the diffuse background with respect to the galactic plane was investigated. (W.D.M.)

34180 FOURIER TRANSFORM PHOTOGRAPHY: A NEW METHOD FOR X-RAY ASTRONOMY. Ables, J. G. (Univ. of Adelaide). Proc. Astron. Soc. Aust., 1: 172-3(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

X-ray astronomy suffers from a relative dearth of image-forming devices. No x-ray lens is known and image formation by reflection requires glancing incidence optics, which has small fields of view and presents extremely difficult fabrication problems, even for small apertures (~2 cm^2) now employed. The only other imaging device that has been successfully employed is the simplest of all, the pinhole camera. Pinhole cameras with resolutions better than 10^{-3} rad are easily constructed, but the apertures are very small (not greater than about 10^{-4} cm^2). A new instrument is described here that is closely related to the pinhole camera, and may be viewed as an attempt to overcome the aperture restrictions of this simple device. (W.D.M.)

34181 INTERFEROMETRIC OBSERVATIONS OF THE RADIO SOURCE VRO 42 22 01. Seielstad, G. A.; Yip, K. B. (California Inst. of Tech., Pasadena). Nature (London), 222: 967-8(June 7, 1969).

This quasar and its optical counterpart BL Lac are considered to possess especially interesting properties, including the supposed detection of variable circular polarization at 2,695 MHz. Observations at various times and frequencies during 1968 using the interferometer of the Owens Valley Radio Observatory are reported. Data are tabulated for flux density, phase, linear and circular polarization, and position angle of the electric vector. The source diameter appears to be $\lesssim 2''$, and the object is considered to be a point source. Position data agreed well with earlier observations. These appeared to be significant variations of flux density between June and September at both 8.3 and 9.6 GHz, and the flux densities apparently increased during 1968. The source was only weakly linearly polarized at 8.3 and 9.6 GHz, and it may be another example of a source with an "inverted" depolarization rate. No circular polarization was detected with certainty at any frequency or time, although observations were not made at the same time or frequency as when circular polarization was supposedly detected. It is considered premature to conclude that the source contains a very strong magnetic field. (UK)

34182 LIMIT ON THE ANGULAR SIZE OF CYG XR-1. Floyd, F. W. (Massachusetts Inst. of Tech., Cambridge). Nature (London), 222: 967(June 7, 1969).

It is stated that the bright x-ray source Cyg XR-1 presents an interesting problem for size measurement since it has a hard "power-law" x-ray spectrum extending to 100 keV and beyond, like the Crab Nebula, and is apparently highly variable, like Sco X-1. No optical counterpart of Cyg XR-1 has been identified, and hence a direct measurement of its x-ray size may be the only way to determine whether it is a variable x-ray nebula or a stellar object emitting x rays with a power law spectrum beyond 100 keV. Observations are reported that place an upper limit of 1.4 min of arc on the angular diameter of the source in the energy range 25 to 100 keV. The data were obtained from a balloon flight from Palestine, Texas on July 16, 1968, with an instrument comprising a pair of x-ray telescopes with gyro-stabilized modulation collimators. The x rays transmitted by the collimators were detected by NaI (Tl) crystal scintillator detectors. The intensity of Cyg XR-1 was found to be 0.056 ± 0.007 photons cm^{-2} S^{-1} in the 25- to 100-keV range. (UK)

34183 PULSARS AND MAGNETIC AMPLIFICATION. Piddington, J. H. (National Standards Lab., Sydney). Nature (London), 222: 965-6(June 7, 1969).

It has been stated that the pulsar NP 0532, within the Crab Nebula, is probably a rotating magnetic neutron star. The purpose of this communication is to demonstrate that such a star may generate magnetic flux and energy and thus account for the large flux existing within the nebula; also to show that there is now almost direct observational evidence of conversion of gravitational to magnetic energy, as required in radio galaxies and quasars; and to propose an explanation of pulsars as omnidirectional pulsed signals excited by a rotating star. The possibility of flux amplification by hydromagnetic action within the nebula is discussed. The present direct power source is kinetic energy, but the original source was the gravitational energy of stellar collapse with partial conservation of angular momentum. The rotating magnetosphere field and its plasma are completely enclosed by a nonrotating field and plasma which extend from the outer boundary of the plasma to that of the nebula. The boundary between the two configurations oscillates violently as the star rotates, and radiates hydromagnetic waves outwards, removing energy and angular momentum from the star at the rate observed. The waves are also likely to be efficient generators of cosmic rays by the mechanism of magnetic pumping. The model may also account for pulsed optical and radio emissions, provided there is asymmetry in the nonrotating field or plasma. Evidence of plasma in the central region of the Crab is discussed. The model also explains the origin of the Crab magnetic field and the outward acceleration of the shell, the shape of the nebula, and the motion of observed light whisps of plasma. It may also explain the x-ray source, which extends for about 0.3 pc from the center and probably has a synchrotron origin. (UK)

34184 H II REGIONS AND THE DISTANCES TO PULSARS. Prentice, A. J. R.; ter Haar, D. (Oxford Univ.). Nature (London), 222: 964-5(June 7, 1969).

Estimates of pulsar distances are based on their dispersion, which is a direct measure of $\int n_e\, dl$, where n_e is the electron density per cm^3 and the integration is along the line of sight from the pulsar to the Earth. The value 0.1 cm^{-3} has usually been used as a rough estimate for n_e, but there have been indications that this may be much too high in most cases. It was thought that use might be made of knowledge about stars along the line of sight and the general distribution of hydrogen in the Galaxy to give an approximate calculation of n_e along the line of sight and to ascertain at what point the $\int n_e\, dl$ runs out of distance. A programme of work is described which was undertaken to investigate this possibility, taking account of very hot stars, Strömgren radii, the remaining stars in the sky, the level of ionization in H I regions, etc. A table is presented listing all known pulsars, their galactic longitude and latitude, the values of $\int n_e\, dl$ obtained from their dispersion, and their computed distances. It was found that $\int n_e\, dl/l$, which was earlier assumed to be a constant and equal to 0.1 cm^{-3}, varied from 0.01 to 0.3 cm^{-3}, with perhaps clustering around 0.03 to 0.05 cm^{-3}. It thus seems wrong to assume that $n_e \cong 0.1$ cm^{-3} can be uniformly used. Conclusions are also drawn which may put some restriction on possible pulsar models. It is considered that distance determinations could be improved by using detailed data on hydrogen densities. (UK)

34185 UNSUCCESSFUL PULSAR SEARCH AT 1,400 MHz. Bourgois, G.; Guelin, M.; Rieu, N. Q. Nature (London), 222: 963-4(June 7, 1969).

In a pulsar search at 1,400 MHz-carried out in March 1969 using the Nancay transit telescope, no pulsars were discovered. A third of the galactic plane was scanned between plus and minus 2° in galactic latitude. The aim of the survey was to search for pulsars with spectral maxima at high frequencies and for pulsars of very high dispersion. It had been suggested that a thin layer of ionized hydrogen in the galactic plane may produce very high dispersion. Individual pulses from pulsars situated in such a layer would not have been resolved by low frequency surveys, but the pulses should be resolved at 1,400 MHz. The fact that no strong pulsar with a high dispersion was found appears to indicate that observed dispersions are chiefly related to distance. (UK)

34186 THREE NEW PULSARS. Vaughan, A. E.; Large, M. I.; Wielebinski, R. (Univ. of Sydney). Nature (London), 222: 963(June 7, 1969).

Surveys made at the Molonglo Radio Observatory during Feb. and March 1969 resulted in the discovery of new pulsars which are designated MP 0450, 1642, and 1818. The physical parameters of these are tabulated. Using the dispersing layer model due to Mills (Proc. Astron. Soc. Aust., 1: 176(1969)) distances from the Sun of 1, 2, and 700 pC are indicated, respectively. Consideration is given to the extent to which the pulsar search is complete in the area of sky observable with the Molonglo instrument; it is considered that continuation of the search will reveal several more strong pulsars. (UK)

34187 OPTICAL OBSERVATIONS OF BL LAC = VRO 42.22.01. DuPuy, David (Univ. of Toronto Kitt Peak National Observatory, Tucson, Ariz.); Schmitt, John; McClure, Robert; van den Bergh, Sidney; Racine, Rene. Astrophys. J., 156: L135-8(June 1969).

BL Lac is found to exhibit rapid optical variations within the luminosity range $12.0 \leq V \leq 15.5$. The optical spectrum of BL Lac is continuous. The true nature of this remarkable object remains a mystery. (auth)

34188 THE PULSAR NP 0532 AND THE IMPLICATIONS OF THE OBLIQUE-ROTATOR HYPOTHESIS. Boehm-Vitense, Erika (Univ. of Washington, Seattle). Astrophys. J., 156: L131-4(June 1969).

The light curve of the pulsar NP 0532 can be reproduced with the oblique-rotator hypothesis, provided that the light emission is strongly concentrated at two opposite spots on the star and is confined to a narrow cone. (auth)

34189 SEARCHES FOR PULSARS. Reifenstein III, E. C.; Brundage, W. D.; Staelin, D. H. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astrophys. J., 156: L125-30(June 1969).

Three distinct pulsar-search strategies employed at the National Radio Astronomy Observatory are described. Two searches incorporated techniques which sought periodic dispersed pulse trains, one search covering about half the available sky for periods near 1 sec and the other covering about 59 specific regions for periods down to 0.01 sec. The third program involved visual searches of the time frequency plane for isolated dispersed pulses in the same lift of 59 regions. The searches resulted in the discovery of NP 0527 and NP 0532 and the confirmation of most other pulsars located in the search zones. (auth)

34190 FARADAY ROTATION IN PULSARS. Staelin, D. H.; Reifenstein III, E. C. (National Radio Astronomy Observatory, Green Bank, W. Va.). Astrophys. J., 156: L121-4(June 1969).

Faraday rotation was measured in NP 0527 and CP0328 near 112 MHz by means of a fifty-channel radiometer mounted on the 300-foot transit telescope of the National Radio Astronomy Observatory. The magnitudes of the rotation measures of these two sources were 36 ± 5 rad m^{-2} and 63 ± 5 rad m^{-2}, respectively, and the corresponding mean longitudinal magnetic fields were 0.9 μG and 2.8 μG, respectively. No unambiguous Faraday rotation was observed in NP 0532, CP 0834, CP 0950, CP 1133, HP 1506, or CP 1919. (auth)

34191 INFRARED AND OPTICAL MEASUREMENTS OF THE CRAB PULSAR NP 0532. Neugebauer, G.; Becklin, E. E.; Kristian, J.; Leighton, R. B.; Snellen, G.; Westphal, J. A. (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J., 156: L115-19(June 1969).

Observations of the pulsating component of NP 0532 at 2.2 and 1.65 μ are given. The energy density per pulse at 2.2 μ is $(3.2 \pm 0.4) \times 10^{-31}$ J m^{-2} Hz^{-1} and forms a smooth continuation of the visual data. (auth)

34192 ANALYSIS OF THE SLOWING-DOWN RATE OF NP 0532. Goldwire, H. C. Jr.; Michel, F. C. (Rice Univ., Houston, Tex.). Astrophys. J., 156: L111-14(June 1969).

A quadratic least-squares analysis of the variation with time of the period of NP 0532, based on the 1967 observations of this pulsar by Fishman, Harnden, and Haymes, indicates that the rate of change of the angular frequency Ω is proportional to Ω^n, where $n = 5 \pm 3$. Implications for present theories of the slowing-down mechanism are discussed. (auth)

34193 OBSERVATION OF PULSED HARD X RADIATION FROM NP 0532 FROM 1967 DATA. Fishman, G. J.; Harnden, F. R. Jr.; Haymes, R. C. (Rice Univ., Houston, Tex.). Astrophys. J., 156: L107-10(June 1969).

An analysis of data obtained during a 1967 balloon-borne measurement of the Crab Nebula reveals the presence of pulsed hard x-radiation at the period of NP 0532. The early date of observation permits an accurate determination of the slow-down rate: 36.51 ± 0.02 nsec day^{-1}. The pulsed luminosity is $7 \pm 2\%$ of the total Crab radiation above 35 keV if the spectral shape of NP 0532 is like that of the nebula at these energies. (auth)

34194 FORMALDEHYDE ABSORPTION IN DARK NEBULAE. Palmer, Patrick (Univ. of Chicago); Zuckerman, B.; Buhl, David; Snyder, Lewis E. Astrophys. J., 156: L147-50(June 1969).

The $1_{11} - 1_{10}$ rotational transition of formaldehyde (H_2CO) was observed in absorption in the direction of four dark nebulae. The radiation that is being absorbed appears to be the isotropic microwave background; this would imply that the excitation temperature of these two levels in these clouds is less than 1.8°K. (auth)

34195 OH AND FORMALDEHYDE RADIATION PROPERTIES OF THE W75 REGION. Rydbeck, O. E. H.; Elldér, J.; Kollberg, E. (Chalmers Univ. of Tech., Gothenburg, Sweden). Astrophys. J., 156: L141-6(June 1969).

After carefully mapping the W75 region it was found that it was composed of two sources, W75A and W75B. The final spectra, at the four OH ground states, at right- and life-circular polarization, are shown for sources A and B. (W.D.M.)

34196 SCHEMATIC MODEL FOR CERTAIN X-RAY SOURCES. Cameron, A. G. W. (Yeshiva Univ., New York. Goddard Space Flight Center, New York). Astrophys. Lett., 3: 171-3(June 1969).

The thin-source bremsstrahlung temperatures of some x-ray sources are in the range expected for mass accretion onto a white dwarf. It is suggested that a variation of the process which produces planetary nebulae may produce a ring of material orbiting close to the surface of a white dwarf star, and that it is mass accretion from this ring which is responsible for the x-ray emission. (auth)

34197 PERIOD DISTRIBUTION OF PULSARS. Hirth, W.; von Reinhardt, M. (Institut fuer Astrophysik und Extraterrestrische Forschung, Bonn). Astrophys. Lett., 3: 169-70(June 1969).

Theoretical period distributions of pulsars were derived using two assumptions on the change of period–period dependence. Agreement with the observed period distribution was obtained in both cases, by assuming a period dependence of the energy output and/or a distribution of the decay time. (auth)

34198 LARGE VARIATIONS IN THE BRIGHTNESS OF SOME QUASI-STELLAR OBJECTS. Bolton, J. G. (Commonwealth Scientific and Industrial Research Organization, Sydney); Wall, J. V. Astrophys. Lett., 3: 177-9(June 1969).

Increases in brightness have permitted the identifications of two radio sources as quasi-stellar objects on recent 48-inch plates. (auth)

34199 RADIO EMISSION FROM THE VICINITY OF THE GALACTIC NEBULA NGC 6857. Wynn-Williams, C. G. (Mullard Radio Astronomy Observatory, Cambridge, Eng.). Astrophys. Lett., 3: 195-9(June 1969).

The Cambridge One-Mile Radio Telescope, operating at 11-cm wavelength, has shown that the unusually intense radio emission hitherto attributed to the planetary nebula NGC 6857 in fact has its origin in four separate compact components which have thermal spectra. One of them coincides with NGC 6857, and another with a second nebula also listed as a planetary, K 3–50, but it is suggested that the source is probably a group of compact high-density H II regions excited by a cluster of OB stars. (auth)

34200 CATALOG OF 37 PULSARS. Taylor, J. H. (Harvard Coll. Observatory, Cambridge, Mass.). Astrophys. Lett., 3: 205-8(June 1969).

A table is given on the 37 known pulsars. Data given for each source include designation, right ascension and declination, galactic coordinates, pulse repetition period, dispersion measure, and approximate pulse width. References to the data are given. (W.D.M.)

34201 MAGNETIC POLES AND THE POLARIZATION STRUCTURE OF PULSAR RADIATION. Radhakrishnan, V.; Cooke, D. J. (Commonwealth Scientific and Industrial Research Organization, Sydney). Astrophys. Lett., 3: 225-9(June 1969).

Comparison of the polarization structure of PSR 0833–45 at different frequencies leads to the conclusion that pulsar radiation must emanate from the neighborhood of magnetic poles. The recent jump in periodicity of this pulsar was not accompanied by any gross changes in its magnetic field structure. (auth)

Solar Phenomena

Refer also to abstracts 34292, 34296, and 34328.

34202 (AD-684762) APPARENT LOCAL JUMP IN THE MOMENTUM TRANSFER RATE AT THE FRONT OF FLARE-FRESH SOLAR PLASMA IN THE INTERPLANETARY SPACE. Lee, Thomas S.; Balwanz, W. W. (Naval Research Lab., Washington, D. C.). Dec. 31, 1968. 20p. (NRL-6784). CFSTI.

It is shown analytically that, because of inertial effects, a gradient singularity of the radial momentum transfer rate arises in association with the local coronal accumulation in front of the rear-propelling contact surface postulated in the theory. Also, it is shown that such a local accumulation is a general result for power-law explosive waves extruding against an ambient hydrogen solar wind having a strictly inverse-square radial decay in density. The usual numerical schemes are rendered ineffective for the determination of the expected singular local wave behavior. To circumvent the difficulty, a combined numerical–integral technique was developed, and was applied on six specific model waves, including both the decelerating and the nondecelerating, which have energies increasing with time as t^K with K = 28, 4, 1, ½, ¼, and ⅛. Also, a local solution corresponding to the limiting approximation of a constant material velocity gradient was analytically constructed. The importance of the local singular behavior is quantitatively appraised, and certain interplanetary implications are given cursory inferences. It is felt the new results should have relevance to the quantitative determination of the progressive peak transverse magnetic field during an interplanetary storm and to the theoretical determination of the macroscopic stability of the postulated contact surface. (auth) (USGRDR)

34203 SOLAR SYSTEM PLASMAS AND X-RAY ASTRONOMY. Conference Held at the University of Adelaide on 12–14 August 1968. Wild, J. P. (ed.). Proc. Astron. Soc. Aust., 1: 124-73 (Dec. 1968). (CONF-680837).

Twenty-eight papers are presented on the solar atmosphere, interplanetary medium, terrestrial atmosphere, theoretical and laboratory astrophysics, and x-ray astronomy. Separate abstracts were prepared for the twenty-eight papers. (W.D.M.)

For abstracts of individual papers see: 34146, 34159, 34167–34169, 34176–34180, 34204–34207, 34209–34211, 34229–34231, 34292, 34294–34297, and 34314–34316.

34204 THE CHEMICAL COMPOSITION OF THE SUN AND THE SOLAR SYSTEM. Aller, L. H. (Univ. of California, Los Angeles). Proc. Astron. Soc. Aust., 1: 133-5(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

Work on the solar chemical composition is briefly reviewed and a progress report is presented on the spectrum synthesis program at the University of California, Los Angeles. (W.D.M.)

34205 SOLAR X-RAY BURSTS OBSERVED ON IMP-F. Harries, J. R. (Univ. of Adelaide). Proc. Astron. Soc. Aust., 1: 136-7(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

Solar x-ray bursts observed by a proportional counter carried on the IMP-F satellite were analyzed for correlation with optical Hα flares and radio bursts. The solar x-ray flux at energies greater than 3 keV was measured each 82 seconds and consisted of impulsive bursts superimposed on a slowly varying x-ray background. During June and July 1967 there were an average of ~10 bursts/day with intensities greater than 400 photons $cm^{-2}s^{-1}$ (2×10^6 erg $cm^{-2}s^{-1}$) which was the threshold for observation of a burst. (W.D.M.)

34206 RADIO EVIDENCE OF A CORONAL INSTABILITY BEFORE THE ONSET OF A SOLAR FLARE (9 JUNE 1968). Wild, J. P. (Commonwealth Scientific and Industrial Research Organization, Sydney). Proc. Astron. Soc. Aust., 1: 137-8(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

The outburst and storm of more than four hours' duration that accompanied the importance 2 flare beginning at 0025 UT on June 9, 1968, were observed at 80 MHz with the Culgoora radioheliograph. More than 10^4 heliograms in both senses of circular polarization were recorded at one-second intervals both as cathode-ray-tube photographs and as digital characters on magnetic tape. It is the purpose of this preliminary account to summarize these observations and bring attention to a new phenomenon observed before the start of the flare. (W.D.M.)

34207 METRE-WAVE DYNAMIC SPECTRUM OF A SOLAR FLARE ON 9 JUNE 1968. Sheridan, K. V. (Commonwealth Scientific and Industrial Research Organization, Sydney). Proc. Astron. Soc. Aust., 1: 138-40(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

Detailed observations of the importance 2 flare of June 9, 1968, 0025 UT, were made at Culgoora in both its Hα and 80 MHz radio emissions, and the event should provide an opportunity for careful study. In this paper, a description is given of the radio spectral observations (25 to 200 MHz) taken at the same site. These observations were among the first to be taken with a newly constructed spectrograph. (W.D.M.)

34208 PRELIMINARY OBSERVATIONS OF THE SUN AT 80 MHz WITH THE CULGOORA RADIOHELIOGRAPH. Kai, K.; McLean, D. J.; Payten, W. J.; Sheridan, K. V.; Wild, J. P.

(Commonwealth Scientific and Industrial Research Organization, Sydney). Proc. Astron. Soc. Aust., 1: 79-81(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

This paper describes a preliminary series of observations of the Sun made at a frequency of 80 MHz with the 3-km radioheliograph of the Culgoora Observatory. The instrument records, at one-second intervals, pictures of the solar image in the form of 60 (E−W) × 48 (N−S) points, each separated in angle by half the Rayleigh limit (2′ arc in the zenith). The observations were made between about 0h and 4h U.T. on Oct. 26−31, 1967. (W.D.M.)

34209 80 MHz HELIOGRAPH OBSERVATIONS OF TWO TYPE IV EVENTS ON 4 AND 6 MAY 1968. Labrum, N. R.; Smerd, S. F. (Commonwealth Scientific and Industrial Research Organization, Sydney). Proc. Astron. Soc. Aust., 1: 140-1(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

Radio pictures of the Sun from the Culgoora radioheliograph have already shown instances in which flares have initiated radio bursts in parts of the Sun remote from the flare position. In this paper two such events on May 4 and May 6, 1968, are discussed, in each of which it appears that shock waves arising from a flare produced distant prominence activity which led to the generation of meter-wave continuum radiation. (W.D.M.)

34210 TYPE II SOLAR RADIO BURSTS OBSERVED WITH THE CULGOORA RADIOHELIOGRAPH DURING A FLARE ON 17 JUNE 1968. Kai, K.; McLean, D. J. (Commonwealth Scientific and Industrial Research Organization, Sydney). Proc. Astron. Soc. Aust., 1: 141-2(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

On June 17,1968, a flare event was observed with the 80-MHz Culgoora radioheliograph that consisted of a sequence of two type-II bursts followed by enhanced emission possibly of type IV. An attempt is made to summarize some of the profuse data collected by the radioheliograph during this event and relate it to data from the radiospectrograph and Hα films of the associated flare. (W.D.M.)

34211 PRELIMINARY OBSERVATIONS OF THE EFFECTS OF A COROTATING STREAM ON INTERPLANETARY SCINTILLATION. Dennison, P. A.; Wiseman, M. (Univ. of Adelaide). Proc. Astron. Soc. Aust., 1: 142-5(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

Observations are described of a "grid" of radio sources which, over a period of several days, have shown systematic changes in their scintillation indices and in the power spectra of the scintillations apparently related to the passage of a co-rotating stream through the interplanetary medium. (W.D.M.)

34212 A MORPHOLOGICAL STUDY OF THE SOLAR GRANULATION. Namba, O.; Diemel, W. E. (Astronomical Observatory, Utrecht). Solar Phys., 7: 167-77(May 1969).

Some properties of the photospheric granulation near the center of the quiet Sun were investigated on the basis of two high-definition Stratoscope photographs. Results obtained include (1) a number density of 54 granules per 10″ × 10″, (2) a total number of granules on the whole surface of 6.3×10^6, (3) a mean cell diameter of 1.5″ or 1100 km and a mean granule diameter of 1.2″ or 850 km, the difference of 250 km being ascribed to the mean width of the dark intergranular lanes, (4) frequency distributions of cell diameters and granule diameters, and (5) an isophotal map in relative intensity. In general, larger granules are brighter than smaller granules. Cross-section profiles are shown for some granules and intergranular lanes. These quantities have not yet been corrected for the finite resolution of the telescope. (auth)

34213 EFFECT OF FINITE RESOLUTION ON SOLAR GRANULATION. Musman, Steve (Sacramento Peak Observatory, Sunspot, N. Mex.). Solar Phys., 7: 178-86(May 1969).

Some numerical experiments were performed in order to simulate the effect of finite resolution on solar granulation. When a two-dimensional pattern is smeared, another pattern emerges whose nature depends on the width of the smearing function rather than the original pattern. The size of the structures present in a typical granulation photograph is about that which would be expected from the smearing of smaller structures by the effect of atmospheric "seeing." Only Stratoscope photographs appear to have unambiguously determined the nature of solar granulation. (auth)

34214 FREQUENCY SPECTRA OF SOLAR IMAGE MOTION. Brandt, P. N. (Fraunhofer Institut, Freiburg i. B.). Solar Phys., 7: 187-203(May 1969).

The frequency analysis of image motion (IM) at the solar limb was carried out in the frequency range from 0.5 to 50 Hz using a photoelectric equipment. For a telescopic aperture of 35 cm and a bandwidth of 0.65 Hz a typical frequency spectrum under average observing conditions shows a decrease of amplitude from 2 arcsec at 0.5 Hz to 0.4 arcsec at 5 Hz, 0.03 arcsec at 50 Hz (and <0.01 arcsec at 500 Hz). Visually estimated values of image steadiness seem to be in better agreement with the rms value of image motion (scattering parameter σ) than with the amplitude at a certain frequency. The influence of IM on the quality of photographic pictures or on spectra of solar fine structures is calculated as a function of exposure time. The IM scattering parameters σ (0.01 arcsec to 4 arcsec) calculated for exposure times from 0.001 to 0.5 sec are given. The modulation transfer functions (MTF, one-dimensional) derived from the IM scattering parameters are presented together with the MTF for a diffraction-limited telescope of 35 cm aperture at λ 6000 Å. Exposure times of less than approximately 0.01 sec (certain within a factor of 2) render the influence of IM negligible compared to the MTF of the objective used for this investigation. (auth)

34215 NONDIVERGENT OSCILLATIONS IN THE SOLAR ATMOSPHERE. Jones, Walter L. (National Center for Atmosphere Research, Boulder, Colo.). Solar Phys., 7: 204-9 (May 1969).

Nondivergent oscillations having the form of deep water waves are shown to form normal modes or free oscillations of the solar atmosphere under two approximations: the chromosphere-coronal interface behaves like a free surface, and the density scale height is sufficiently large in the convective zone. These modes show the temporal and spatial characteristics of the "300 second" chromospheric oscillations. (auth)

34216 ON THE PROBLEM OF ACTIVE LONGITUDES OF SUNSPOTS AND FLARES. Vitinskii, Yu. I. (Pulkovo Observatory, Leningrad). Solar Phys., 7: 210-16(May 1969).

The active longitudes of indices for sunspot activity and solar flares were detected and investigated by the method of isoline for the period July 1, 1957 to December 31, 1962. In the most active hemisphere of the Sun, the active longitudes of sunspot and flares appear to coincide. It is shown that the rate of concentration in the active longitudes is the highest for more important formations. Arguments for the reality of the active longitudes of sunspot areas are advanced. In conclusion the question of the influence of the uncertainty of the solar rotation period on the detection of active longitudes of flares is considered. (auth)

34217 FAR-INFRARED OBSERVATION OF A SUNSPOT. Lena, Pierre (Univ., Paris). Solar Phys., 7: 217-20(May 1969).

In a recent paper, Henoux (1968) made observations on a sunspot at 2.2μ. From the observations an empirical sunspot model and a law for the reduced temperature (Θ = 5040/T) vs optical depth at 5000 Å were derived. An observation made with the MacMath Solar Telescope on Dec. 28, 1967, on a large sunspot is reported. The spot was comparable in size and shape to Henoux's spot. Scans of the spot were made at a wavelength of 24μ, using interference and restrahlen filters to define the band pass (of the order of 2μ). (W.D.M.)

34218 PHOTOMETRIC COMPARISONS OF HYDROGEN AND HELIUM EMISSIONS IN EXTERNAL REGIONS OF PROMINENCES. Leroy, Jean-Louis (Observatoire du Pic-du-Midi, France). Solar Phys., 7: 221-37(May 1969). (In French).

This study follows a previous paper (Leroy, 1967) in which it was shown that the emissions of He in D3 and of H in Hα have generally the same distribution in a prominence. The first paper was mainly devoted to the central (bright) parts of prominences so it appeared desirable to carry out observations with special attention to the faint outer parts of prominences. Out of a collection of images in Hα and in D3, two series were chosen that showed prominences lying over the chromosphere. (W.D.M.)

34219 SPLINTERING-LOOP PROMINENCES. Kleczek, J. (Univ. Observatory Sonneborgh, Utrecht). Solar Phys., 7: 238-42(May 1969).

A new type of sunspot prominences ("splintering loop prominences") is described. They have loop structure, but their material seems to originate from the lower layers. A tentative interpretation of the new type is given. In the splintering loop prominences on October 7, 1967, a phenomenon was observed which might be interpreted as the capture of an ejected prominence streamer by transverse magnetic fields of the loops. (auth)

34220 TWO PROMINENCE ERUPTIONS AND THE PROBLEM OF EMISSION. Zirin, Harold (Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Solar Phys., 7: 243-52(May 1969).

Two flare unconnected eruptions on January 15 and 29, 1968, are

discussed. The first is a filament which turns bright and erupts upward, reappearing an hour later. The second is a large eruptive arch seen against the disk. The arch is bright at the top of its trajectory, turns dark, but produces chromospheric emission at the point of impact. The emission at the top of the arch is ascribed to the velocity shift of the illuminating chromospheric Hα line. It is shown that such emission will occur only if the motion is transverse to the line of sight and the prominence is optically thin. (auth)

34221 PROFILES OF THE H AND K LINES OF CaII IN DISK FLARES. Malville, J. Mckim; Tandberg-Hassen, Einar; Zei, Dino (National Center for Atmospheric Research, Boulder, Colo.). Solar Phys., 7: 253-9(May 1969).

The profiles of the resonance lines of CaII were studied in two large disk flares and in the surrounding plage. In the brightest portions of the flares no self-reversal in the central emission core was detected; self-reversed cores were present in the less bright portions of the flares. It was found that as the intensity of the emission core increased the separation of the H_2 and K_2 peaks decreased monotonically, becoming unobservable at intensities near to 0.90 the local continuum. Possible reasons for the behavior of the H and K lines in flares are considered. It is suggested that the largest density enhancements in flares are found near the strongest magnetic field. (auth)

34222 DIRECTIVITY OF SOLAR HARD X-RAY BURSTS. Ohki, Ken-ichiro (Tokyo Univ.). Solar Phys., 7: 260-7 (May 1969).

Solar hard x-ray bursts (>10 keV) seem to show a center-to-limb variation, while softer x-ray bursts show no directivity. This effect of hard x-ray bursts may be due to the directivity of the emission itself. As the cause of the directivity, two possibilities are suggested. One is the inverse Compton effect and the other is the bremsstrahlung from anisotropic electrons. (auth)

34223 THE SLOWLY VARYING COMPONENT OF THE SOLAR RADIO EMISSION AROUND 1-cm WAVELENGTH. Tsuchiya, Atsushi (Tokyo Univ.). Solar Phys., 7: 268-75 (May 1969).

The slowly varying component of solar radio emission (S component) was investigated from data obtained in the United States and Japan at 35, 17, 9.4, and 4 GHz. A good correlation occurs between the 35-GHz flux of the S component and the corresponding plage area. This is interpreted by the assumption that the 35-GHz radiation is due to pure free–free emission, and the electron density in the coronal condensation is estimated to be about 2×10^8/cm^3, assuming the electron temperature to be 2×10^6 K and the scale height of the coronal condensation to be 3×10^4 km. The S-component radiation at 17 GHz has, in turn, two components; one is due to pure free–free emission and the other is due to thermal-gyro emission. It is concluded that in the active regions a magnetic field of more than 2000 gauss extends horizontally over about 10^4 km. (auth)

34224 RADIO OBSERVATION OF THE SOLAR ECLIPSE OF MAY 20, 1966. Drago, F. G.; Noci, G. G. (Univ., Florence). Solar Phys., 7: 276-94(May 1969).

The eclipse of May 20, 1966, was observed at the wavelengths of 3.2 and 9.1 cm by three Arcetri expeditions. The curves obtained by deriving the occultation curves have been filtered by digital techniques to cut off high-frequency noise; by them, many characteristics of three sources of the S component present on the disk have been studied: temperature, dimensions, emitted flux, and brightness distribution. Isophotes of the latter are compared with isophotes of the corresponding Hα plages for two sources: a close similarity results for one of them. Moreover it is shown that: (a) the height above the photosphere of the sources at $\lambda = 9.1$ cm is greater than that of the sources at $\lambda = 3.2$ cm; (b) the maximum of the radio emission is not always placed exactly above a sunspot or above the sunspot group barycenter. Fitting the observed brightness temperatures, as frequency functions, by a power law and using a temperature model of an active region, the electron density distribution can be deduced. The obtained electron density distributions are compared with various models of active regions. (auth)

34225 SOLAR X RADIATION DURING ECLIPSE OF May 20, 1966. Simon, G. (Observatoire de Meudon, France). Solar Phys., 7: 295-301(May 1969). (In French).

The solar eclipse of May 20, 1966, was observed by the Naval Research Laboratory's satellite 1965–93 A. The photocells which were working at this moment operated in the 1 to 8, 8 to 16, 1080 to 1350, 1225 to 1350 Å bands. The data were telemetered by the Centre National d'Études Spatiales's stations of Brazzaville, Ouadagoudou, Hammaguir, and Bretigny. The satellite entered twice in the penumbral zone and three x sources were occulted successively. Their angular dimensions and the flux they emitted were measured and compared to radio observations. (auth)

34226 A STUDY OF THE COMPOSITION OF THE LOWER SOLAR CORONA. Nakada, M. P. (Goddard Space Flight Center, Greenbelt, Md.). Solar Phys., 7: 302-20(May 1969).

Some trends in the composition of the lower solar corona due to mixing and diffusion were examined. Mixing was treated through plausible inference from the thermal gradient and through analogy with the neutral atmosphere of the earth. These indicate that diffusion may be important in the lower corona. Changes in composition due to pressure and thermal gradients were calculated with multi-component diffusion equations. Results indicate that (i) large enhancements of heavy elements are possible and (ii) the composition of the corona can show large variations with values of the thermal gradient in the lower corona. (auth)

34227 HEATING OF THE SOLAR CORONA. D'Angelo, N. (European Space Research Inst., Frascati, Italy). Solar Phys., 7: 321-8(May 1969).

The suggestion is advanced that heating of the solar corona results from Landau damping of ion-acoustic waves generated in the motion of photospheric granules. Laboratory experiments relevant to the question of corona heating are discussed, together with the available observational information on the extent of energy deposition in the corona. (auth)

34228 A METHOD TO OBTAIN A SOLAR VELOCITY MAP DIRECTLY IN ONE SPECTROHELIOGRAM. Bhatnagar, A. (Carnegie Inst. of Washington, D. C. California Inst. of Tech., Pasadena).; Stenflo, J. O. Solar Phys., 7: 329-30(May 1969).

Recently a method to obtain a map of solar magnetic fields directly in one photograph was developed by Stenflo (1969). By modulating the circularly polarized light entering a spectroheliograph, a spectroheliogram could be obtained showing a fringe pattern in the magnetic regions on the Sun. The same technique can be extended to velocity fields. To obtain a two-dimensional map of solar velocity fields, the only modification of a normal spectroheliograph needed is the use of two slightly tilted plane parallel glass plates before the second slit. A tachoheliogram demonstrating the method is given. (W.D.M.)

34229 COROTATING FORBUSH DECREASES. McCracken, K. G.; Palmer, I. (Univ. of Adelaide). Proc. Astron. Soc. Aust., 1: 145-6(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

The observation of an energetic storm particle event in association with a solar-flare Forbush decrease leads naturally to the question of whether there may be a proton enhancement associated with a recurrent Forbush decrease. Evidence is presented for such an association from events of Aug. 22, 1966. (W.D.M.)

34230 TIME STRUCTURE OF SOLAR FLARE PROTON EVENTS. Stone, B. J. (Univ. of Adelaide). Proc. Astron. Soc. Aust., 1: 148-9(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

This paper is a progress report on an examination of the short-term variability of solar proton flux in interplanetary space at times of solar-flare activity. The data are from the GRCSW cosmic-ray detector on board the Pioneer 7 space probe, which, at the times discussed, was more than a million miles from the Earth. (W.D.M.)

34231 RESISTIVE INSTABILITIES AND SOLAR FLARES. Lister, G. G. (Flinders Univ., Bedford Park, South Australia). Proc. Astron. Soc. Aust., 1: 152-3(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

A two-dimensional flat geometry is appropriate for the initial stage of flare development, but it appears that the mechanism proposed by Sturrock (1967) calls for a cylindrical geometry. Both geometries are discussed and the effects of plasma compressibility is included. A finite value of γ, the ratio C_p/C_v of specific heats, is assumed. (W.D.M.)

34232 INTERACTION BETWEEN THE BOUNDARY OF THE HELIOSPHERE AND THE MAGNETOSPHERE OF JUPITER. Lanzerotti, L. J.; Schulz, M. Nature (London), 222: 1054-5 (June 14, 1969).

Because of the interstellar medium the supersonic solar wind is believed to undergo a shock transition to subsonic flow at a distance R_h from the center of the Sun. Recent estimates of the position of this shock transition (heliosphere boundary) suggest a value of 5 to 10 AU for R_h. It is considered that such a heliosphere boundary position could profoundly affect the configuration of the Jovian magnetosphere, and that the location of this boundary may be important in understanding the inverse correlation between sunspot number and the probability of Jovian decametric radio emission. The present communication analyzes these possibilities. (UK)

34233 A METHOD FOR DETERMINING SOLAR PROTON SPECTRA. Heristchi, Dj.; Barouch, E.; Masse, P. (CEN, Saclay, France). Nucl. Instrum. Methods, 71: 353-7(1969). (In French).

A simple method for determining the energy spectrum of solar cosmic ray particles is described. This consists in measuring the angular distribution of the particles in the atmosphere (at balloon altitudes). It is shown that the distribution is related to the energy spectrum at the top of the atmosphere. The angular distribution may be measured by comparing the counting rates in two detectors of different aperture. Curves showing the use of the method in a rather common application are shown and discussed. (auth)

34234 SOLAR ACTIVITY IN THE YEAR 1967. Waldmeier, M. (Eidgenoessische Sternwarte, Zurich). Vierteljahresschr. Naturforsch. Ges. Zuerich, 113: 187-207(June 1968). (In German

Frequency numbers on sunspots, photospheric faculae, prominences, intensity of the coronal line 5303 Å, and solar radio emission at 10.7 cm for solar activity in 1967 are given as follows: mean daily sunspot relative number, 93.8; lowest sunspot relative number, 17; highest sunspot relative number, 197; mean daily group number, 7.9; total number northern spot groups, 353; total number southern spot groups, 209; mean equatorial distance northern spot groups, 18.2°; mean equatorial distance southern spot groups, 20.7°; surface covered by fields of faculae, northern hemisphere, 6.7%; surface covered by fields of faculae, southern hemisphere, 3.4%; mean equatorial distance northern faculae, 21.3°; mean equatorial distance, southern faculae, 23.0°; mean daily profile surface of prominences, 5616; mean daily value, total emission at 5303 Å, 632.5; mean daily value, 10.7 cm, 143.3. Daily values of relative numbers, group numbers, and radio emission, distribution in latitude of spots, faculae, prominences, and coronal intensity are tabulated and graphed. (BBB)

34235 RADAR EXPLORATIONS OF THE SUN AND PHYSICAL PROCESSES OF THE SOLAR CORONA. Gordon, I. M. (Inst. of Radio Physics and Electronics, Kharkov). Astrophys. Lett., 3: 181-8(June 1969).

The main components of radio echoes from the Sun arise in restricted parts of the corona situated above plages; reflections from the quiet corona are very weak or completely absent. Conclusions about the inhomogeneous filamentary structure of the active corona, based on an analysis of radio echoes from the Sun, agree with new data on the location of the sources of type-III solar radio bursts. The striking similarity between the position of the regions of enhanced x-ray emission and the strongly reflecting "spots," and between the wide limits in which both the x-ray flux and effective radar cross sections are changing is not accidental. They are determined by the leading role which plasma turbulence plays in supplying energy to layers irradiated by x-ray emission, and in the combination backscattering that is responsible for the formation of the reflected radio signals. (auth)

34236 SECULAR STABILITY OF DIFFERENTIAL ROTATION AND THE SOLAR OBLATENESS. Fricke, K. (Univ., Goettingen, Ger.). Astrophys. Lett., 3: 219-23(June 1969).

Goldreich and Schubert have derived an upper bound for the solar oblateness based on stability arguments. The problem is re-examined using a more relevant and stronger stability criterion. This leads to an appreciably lower value for the maximum oblateness, which cannot account for the measured value reported by Dicke and Goldenberg. (auth)

34237 MICROWAVE POLARISATION MEASUREMENTS OF FOUR SOLAR RADIO BURSTS. Cribbens, A. H.; Matthews, P. A. (University Coll., London). Astrophys. Lett., 3: 215-18(June 1969).

Details of the polarization of four solar radio bursts observed at 2.8 GHz are discussed. (auth)

Galaxies

Refer also to abstracts 34147, 34152, and 34165.

34238 GALACTIC LANE WITH LOW ABSORPTION. Lynga, G. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust., 1: 92-3(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

Photometric data and spectral classes are given for some OB stars in galactic longitudes 298 to 306°. The data were obtained using a photoelectric photometer on the Reynolds reflector and the Meinel spectrograph on the 100-cm reflector at Siding Spring. For determination of absorption and distances it was assumed that $R = A_V/E_{B-V} = 3.0$. (W.D.M.)

34239 FREQUENCY REDISTRIBUTION DURING SCATTERING. Argyros, J. D. (Univ. of Queensland, Brisbane). Proc. Astron. Soc. Aust., 1: 106-7(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

A model for the frequency redistribution during scattering is considered. It is concluded that the indiscriminate use of a frequency-independent source function can at times (e.g., resonance scattering) prove unwise. (W.D.M.)

34240 NEUTRAL HYDROGEN OBSERVATIONS OF NGC 5236. Lewis, B. M. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust., 1: 104-5(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

NGC 5236 was the fourth galaxy beyond the local group to be investigated at Parkes. Most of the observations were made with a single-channel 21 cm line receiver, coupled to the 210 ft dish. The half-power beamwidth was 13.5′. Declination scans were made through the galaxy and treated by previously established methods. The peak antenna temperature was 1.5°K. Profiles of signal strength vs velocity were constructed for a grid of points spaced at 6′ intervals across the galaxy. (W.D.M.)

34241 INTERSTELLAR GAS DYNAMICS. Dixon, M. E. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust., 1: 96(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

An hypothesis is presented which states that nongravitational forces exert an appreciable influence on the motion of interstellar gases. If the hypothesis is true, its implications are far reaching. Some indirect tests that support the hypothesis are mentioned and various conclusions are given. (W.D.M.)

34242 SOME ASTROPHYSICAL IMPLICATIONS OF RECENT MEASUREMENTS ON THE INTENSITY OF COSMIC-RAY ELECTRONS. Webber, W. R. (Univ. of Adelaide). Proc. Astron. Soc. Aust., 1: 112-13(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

Recent measurements on the extraterrestrial cosmic electron spectrum have been extended, this spectrum now being determined over the energy range from ~15 MeV to 6 GeV. The electron intensity between 15 and 200 MeV can be determined unambiguously by studying the diurnal variation of these particles. The effects of the 11-year solar modulation on the electrons have also been measured, thus enabling the electron spectrum observed near the Earth to be extrapolated to the local region of the spiral arm. It is the purpose of this paper to relate these measurements to: (i) calculations of "secondary" electrons produced by cosmic nuclei moving in the Galaxy; and (ii) the observations of nonthermal radio emission from disk components of the Galaxy. (W.D.M.)

34243 PHOTOELECTRIC OBSERVATIONS OF SHORT-PERIOD CEPHEIDS IN THE MAGELLANIC CLOUDS. Gascoigne, S. C. B. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust., 1: 96-7(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

Two-color photoelectric light curves were obtained for 9 SMC and 7 LMC variables, with periods in the range 1.24 to 6.61 days. The LMC cepheids were in the vicinity of NGC 1805–1818. The majority of those in the SMC were immediately south of NGC 362. Plotted against log P, the photoelectric colors and magnitudes show a good deal less scatter than previous photographic observations of the same stars, with some differences of as much as a magnitude. (W.D.M.)

34244 SPECTROPHOTOMETRY OF THE NUCLEUS OF GALAXY NGC 1052 FROM 3400 TO 6300 A. Alloin, Danielle; Andrillat, Yvette (Laboratoire d'Astronomie, Herault, France. Institut d'Astrophysique, Paris). Compt. Rend., Ser. B, 268: 1214-17(May 5, 1969). (In French).

A spectrophotometric study of various nuclei of galaxies was undertaken with the aim of specifying their stellar and gaseous components. A description is given here of the optical spectra of the nucleus of the elliptical galaxy NGG 1052, having an exact radio component. (tr-auth)

34245 INTEGRATED MAGNITUDES AND COLORS OF THE FOUR BRIGHTEST GLOBULAR CLUSTERS IN FORNAX. Demers, S. (Cerro Tololo Inter-American Observatory, La Serena, Chile). Astrophys. Lett., 3: 175-6(June 1969).

Integrated V magnitudes, B–V and U–B colors of four of the five globular clusters in Fornax were measured with a 30 sec of arc diaphragm. Colors can be identified with colors of metal-poor globular clusters in the Milky Way. (auth)

34246 A SEARCH FOR DIFFUSE GALACTIC LIGHT IN THE SPECTRAL REGION λλ2100 TO 2800 Å. Lillie, C. F. (Univ. of Wisconsin, Madison); Witt, A. N. Astrophys. Lett., 3: 201-4 (June 1969).

Rocket measurements of the night sky brightness in the spectral region 2100 to 2800 Å were examined for the presence of a diffuse galactic light component. No evidence for the existence of diffuse galactic light was found, indicating a low albedo of the interstellar dust at these wavelengths. From the data an upper limit can be set to the albedo of the particles at $\gamma = 0.2 \pm 0.2$ in this spectral region. (auth)

Cosmology

Refer also to abstract 34596.

34247 ROLE OF EVOLUTION IN OBSERVATIONAL COSMOLOGY. Mitchell, George Ferguson. Toronto, Univ. of Toronto, 1968.

Thesis.

Apparent magnitude–redshift relations were calculated for a variety of general relativistic cosmological models. The cosmological constant was not set to zero, as is often done, but was considered one of the parameters. A test is described which determines that theoretical model which best fits the observations. This apparent magnitude–redshift test was applied to three classes of astronomical objects: the brightest members of clusters of galaxies; radio galaxies; and quasi-stellar objects. The brightest cluster galaxies were found to be the most useful type of object for this test due to their homogeneous intrinsic properties. The galaxy observations without evolution indicated a closed Universe with positive spatial curvature and a small positive cosmological constant, with a density two orders of magnitude greater than the observed mean density in the form of galaxies. Various existing schemes of galaxy evolution were examined and evolutionary corrections were applied to the observations. The test results for general relativistic cosmological models indicated that galaxy evolution can decrease the density of the best fitting model to agree with the observed mean density of the Universe. Apparent magnitude–redshift relations were also calculated for cosmological models based on the scalar–tensor theory of gravitation of Brans and Dicke. They were found to be very similar to the corresponding relations for general relativistic models with zero cosmological constant. Only in extremely high density models are there appreciable differences between the two theories. The time-variation of the gravitational "constant" in the Brans–Dicke theory results in an additional component of galaxy evolution. A preliminary test shows that even a fairly slow rate of conventional galaxy evolution when combined with this additional component, results in a low density Brans–Dicke model with negative curvature. An attempt was made to interpret the observed radio source counts by assuming (i) constant source power, (ii) a dispersion in source luminosity, and (iii) source evolution and luminosity dispersion. Although it is possible to fit the observations in any given model universe by imposing a suitable rate of evolution on radio sources, it was found to be impossible to obtain the correct model from radio source counts until some limits can be put on the rate of radio source evolution. (Disser. Abstr.)

34248 OLD UNIVERSES AND GALAXY EVOLUTION. Chambers, R. H.; Roeder, R. C. (Univ. of Toronto, Can.). Astrophys. Space Sci., 3: 530-41(Apr. 1969).

It is assumed that the Universe can be represented by low-density Friedmann models with non-zero cosmological constant and long ages. By comparing theoretical and observational apparent magnitude–redshift relations, the rates of galaxy evolution required to force coincidence of these relations in visual light are deduced for each model. These rates are compared with various recent estimates of this effect and are also used to predict the slope of the bright end of the luminosity function of elliptical galaxies. Both the comparison and the prediction indicate that, unless the slope of the bright end of the luminosity function is considerably flatter than that produced by extrapolation, it is impossible to assign all of the difference between theory and present observations to evolutionary effects. Such an assignment could, however, be made if a dispersion in the luminosities of the most distant galaxies is found. (auth)

34249 COSMOLOGY AND QUANTUM ELECTRODYNAMICS. Hoyle, F.; Narlikar, J. V. (Univ. of Cambridge, Eng.). Nature (London), 222: 1040-2(June 14, 1969).

Further investigations in quantum electrodynamics show how the radiative processes can be described without infinities in terms of cosmology and the direct-particle theory of electrodynamics. (auth)

34250 VELOCITY OF THE EARTH WITH RESPECT TO THE COSMIC BACKGROUND RADIATION. Conklin, E. K. (Stanford Univ., Calif.). Nature (London), 222: 971-2(June 7, 1969).

It is pointed out that the discovery of the 3°K background radiation has provided a new tool for studying the Universe and there is evidence that this radiation was produced at an early stage in the expansion of the Universe. If this is true, the radiation defines an extremely distant reference frame—that of the matter which last scattered the radiation. If the Earth has a total velocity v with respect to this frame, there will be an apparent excess of radiation of magnitude $(v/c)\cos\theta$ in the direction of motion, and the preliminary experimental results described show a definite excess with this kind of angular variation. Assuming that intrinsic anisotropy is negligible, a large value for the Earth's motion is indicated in addition to rotation around the Galaxy. The experimental studies were made using a radiometer operating at 8,000 MHz, with 1,200-MHz bandwidth, at the White Mountain Research Station of the University of California. (UK)

34251 SEARCH FOR HYDROGEN APPEARING IN MERCURY METAL. Cohen, S. A.; King, J. G. (Massachusetts Inst. of Tech., Cambridge). Nature (London), 222: 1158-9(June 21, 1969).

Studies are described which may have a bearing on evidence for the continuous creation of matter and the steady state theory of the Universe. It is not known in what form newly created matter would appear, but hydrogen seems a likely candidate. The authors describe some experimental tests of the mass-proportional creation of hydrogen. In order to trap and separate the hydrogen from the bulk matter within which it would be created, the simple technique of freezing and boiling mercury was adopted. Assuming that the continuous creation is proportional to the amount of mass in a volume it is estimated that distillation of 1 mole of mercury should release 9×10^8 H atoms for each second during which the mercury was in the frozen state. The apparatus employed is described; it included an omegatron mass spectrometer. For the 0.6-filter volume used, the corresponding pressure increase was 4×10^{-11} torr/sec. The amount of H_2 detected decreased steadily as the number of distillations increased, regardless of the time between distillations. The data indicate a ratio of observed to predicted pressure amounting to 5×10^{-5} or less, and if mass proportional creation was occurring in the apparatus, it was proceeding at a rate $< 4 \times 10^{-23}$ g/g/sec. (UK)

34252 ULTRAVIOLET ASTRONOMY. Goldberg, Leo. Sci. Amer., 220: No. 6, 92-102(June 1969).

The Orbiting Astronomical Observatory (OAO-II), placed in orbit in Dec. 1968, is providing a systematic sampling of the ultraviolet output of some 50,000 stars. Some of the preliminary findings of OAO-II are reported and some of the fundamental questions about the Universe which ultraviolet astronomy is expected to answer are discussed. (W.D.M.)

34253 THE STABILITY OF THE SCHWARZSCHILD METRIC. Vishveshwara, C. V. College Park, Md., Univ. of Maryland, 1968. 107p.

Thesis.

The stability of the Schwarzschild exterior metric against small perturbations is investigated. The exterior extending from the Schwarzschild radius r = 2m to spatial infinity is visualized as having been produced by a spherically symmetric mass distribution that collapsed into the Schwarzschild horizon in the remote past. As a preamble to the stability analysis, the phenomenon of spherically symmetric gravitational collapse is discussed under the conditions of zero pressure, absence of rotation, and adiabatic flow. This is followed by a brief study of the Kruskal coordinates in which the apparent singularity at r = 2m is no longer present; the process of spherical collapse and the consequent production of the Schwarzschild empty space geometry down to the Schwarzschild horizon are depicted on the Kruskal diagram. (TSS) (Disser. Abstr.)

34254 COMMENTS ON ASTROPHYSICAL CONSEQUENCES OF DIRAC'S HYPOTHESIS OF A VARIABLE GRAVITATIONAL NUMBER, BY H. DEHNEN AND H. HONL. Barnothy, Jeno. Astrophys. J., 156: L159-60(June 1969).

The calculations of Dehnen and Hönl lead to a ratio of QSOs to galaxies 10^3 times larger than that observed. (auth)

34255 ANGULAR VARIATIONS IN THE BACKGROUND RADIATION CAUSED BY MACROSCOPIC MOTIONS OF THE METAGALACTIC MEDIUM. Chibisov, G. V.; Ozernoi, L. M. (Lebedev Inst. of Physics, Moscow). Astrophys. Lett., 3: 189-93(June 1969).

The contribution of scattering by moving plasma to angular fluctuations of the microwave background is considered. The upper limit of temperature inhomogeneities as a function of the

present matter density is given using the concept of pregalactic whirl motions. (auth)

Planetary Phenomena

Refer also to abstract 34232.

34256 THE EFFECT OF IO ON JUPITER'S DECAMETRIC EMISSIONS. McCulloch, P. M. (Univ. of Tasmania, Hobart). Proc. Astron. Soc. Aust., 1: 81-2(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

Io has been observed to strongly modulate the probability and intensity of Jupiter's decametric emissions. The effect is most pronounced at frequencies greater than 30 MHz. The two types of theories that have been proposed to explain the modulation are discussed. (W.D.M.)

34257 A TWO COMPONENT MODEL OF CHANGES IN JUPITER'S RADIOFREQUENCY ROTATION PERIOD. Register, H. I.; Smith, A. G. (Univ. of Florida, Gainesville). Astrophys. Lett., 3: 209-13(June 1969).

A two-dimensional analysis suggests that the decametric emission from Jupiter's principal source is divided into an Io-related component which rotates at constant angular velocity and an Io-independent component which displays a variable rotation period. (auth)

Atomic and Molecular Physics

Refer also to abstract 34546.

Atomic, Electron, Ion, and Molecular Beams and Their Reactions

34258 (ORNL-tr-2126) A UNIVERSAL MONTE CARLO METHOD FOR THE SOLUTION OF ELECTRON TRANSPORT PROBLEMS. Wittig, Siegmar (Frankfurt Univ. (West Germany). Institut fuer Kernphysik). Translated for Oak Ridge National Lab., Tenn., from report IKF-20, 54p. Dep. CFSTI.

An abstract of the original German report appeared in NSA 23: 14853. (L.M.T.)

34259 THE MEASURED ENERGY LOSS OF HIGH-ENERGY ELECTRONS IN ALUMINUM. Bumiller, F. A.; Buskirk, F. R.; Dyer, J. N.; Miller, R. D. (Naval Postgraduate School, Monterey, Calif.). Z. Phys., 223: 415-24(1969).

The energy distributions of electrons of about 54, 75, and 97 MeV have been measured before and after passing through aluminum absorbers of thicknesses ranging from 0.730 to 5.574 g/cm^2. The electrons were accelerated by the LINAC of the Naval Postgraduate School. The most probable energy losses agree with the theory of Blunck and Westphal for all thicknesses; the half widths of the distributions agree with theory except for large thicknesses, where they exceed the theoretical values. These results are in contrast to those of Breuer, which indicate systematically large half widths and most probable energy losses greater than theory for thicknesses greater than about 2 g/cm^2. Since the data agree with those of Breuer, the difference occurs in the treatment of the theory. (auth)

34260 ATTENUATION AND LIFETIME OF HOT ELECTRONS INJECTED INTO LIQUID HELIUM. Onn, David G.; Silver, M. (Univ. of North Carolina, Chapel Hill). Phys. Rev., 183: 295-307(July 5, 1969).

Current densities up to 10^{-9} A cm^{-2} were obtained by injection of hot electrons from a cold-cathode emitter into liquid helium. The current in helium is only 1% of that available from the same devices into vacuum at liquid-helium temperatures. The current attenuation is explained in terms of the electron-helium barrier, the back diffusion of the quasi-free nonlocalized electrons near the emitter surface, and the thermalization of the quasi-free electrons to a localized state while still within the influence of their image potential due to the emitter surface. Using a model based on these three factors, the lifetime of the quasi-free electrons was calculated. In these experiments the lifetime varied from 2.5 psec, for the lowest helium densities and highest-energy electrons, to 0.3 psec for the reverse conditions. (auth)

34261 AUGER EXCITATION BY INTERNAL SECONDARY ELECTRONS. Houston, J. E.; Park, Robert L. (Sandia Labs., Albuquerque, N. Mex.). Appl. Phys. Lett., 14: 358-60(June 1, 1969).

Electron-excited Auger spectroscopy, as it is presently applied, utilizes incident beam energies normally greater than that corresponding to the maximum ionization cross section. Preliminary measurements indicate that Auger emission at these high primary energies is significantly enhanced by excitation by internal secondary electrons. This creates a serious problem with respect to the use of Auger spectroscopy as an analytical tool. (auth)

34262 CALCULATION OF THE BACKSCATTERING COEFFICIENT IN THE CASE OF MONOKINETIC ELECTRONS. Verdier, Pierre; Arnal, Floreal (CNRS, Toulouse). Compt. Rend., Ser. B, 268: 1101-4(Apr. 21, 1969). (In French).

The coefficient of backscattering for a sample bombarded by monokinetic nonrelativistic electrons is obtained very simply from the relations that define transmission phenomena. The values found are compared with those deduced from previous theories. The agreement with experiment is very satisfactory. (tr-auth)

34263 ELECTRON TRANSPORT THEORY USING METHODS OF INVARIANT IMBEDDING. Barrett, Robert Jay. Ames, Iowa, Iowa State Univ., 1968. 77p.

Thesis.

The method of invariant imbedding was applied to electron transport. The reflection and transmission equations were derived for electrons. With the assumption that reflection and backscattering can be neglected, the transmission equation was reduced numerically to a system of first-order differential equations. In making this approximation a Gaussian quadrature formula was used to reduce the integral terms. The computer solutions to this system of equations were used to illustrate some of the advantages and disadvantages of the application of this method to electrons. The accuracy of the solutions was shown to be highly dependent upon the numerical approximation of the integral terms. (Diss. Abstr.)

34264 A SIMPLE TECHNIQUE FOR MEASURING THE STOPPING POWER OF HEAVY IONS IN THE FEW MeV RANGE. Zander, A. R.; Eck, J. S.; Fletcher, N. R. (Florida State Univ., Tallahassee). Nucl. Instrum. Methods, 71: 343-5(1969).

A method is described for measuring the stopping power of solid media for penetrating heavy ions without using heavy ion beams. The method is applicable to any absorber which can be fabricated into a thin foil. Heavy recoil ions are produced by elastic scattering of accelerated beams of relatively light particles. (auth)

34265 COLLISION CASCADES IN GOLD IN THE ENERGY RANGE 3 TO 169 keV. Hancock, R.; Warner, A. G.; Woolley, R. L. (Central Electricity Generating Board, Berkeley, Eng.). J. Phys., D (London), 2: 991-8(July 1969).

Collision cascades of lead ions in gold were studied using the recoil ions from a ThB surface source. The energies of ions scattered by gold-foil targets at angles up to 90° were measured by a time-of-flight technique. Several parameters of the cascade are presented graphically. The mean projected range of 150-keV lead ions in gold is estimated to be 75 μg cm^{-2} and the electronic stopping cross section is found to be 28×10^{-14} eV cm^2/atom, in good agreement with theory. (auth) (UK)

Atomic and Molecular Properties

Refer also to abstracts 34413 and 34549.

34266 (ORNL-4401, pp 160-75) ATOMIC AND MOLECULAR CROSS SECTIONS. (Oak Ridge National Lab., Tenn.).

The following topics are discussed: (1) highly excited Rydberg states of H_2, (2) excitation heating of ions, (3) cross sections for hydrogen particles in magnesium vapor, (4) electrodisintegration of the deuteron, (5) photoionization of krypton between 300 and 1500 eV, (6) production of hydrogen atoms, (7) hydrogen atom energy analyzer, (8) evaluation of a magnetic shield of four nested cylinders, and (9) detector evaluation. (M.O.W.)

34267 INTENSITY OF EMISSION CONTINUUM OF THE NEGATIVE NITROGEN ATOM. Konkov, A. A.; Nikolaev, V. M.; Plastinin, Yu. A. Opt. Spectrosc. (USSR) (Engl. Transl.), 25: 380-2(Nov. 1968).

Translated from Opt. Spektrosk., 25: 679-83(Nov. 1968).

It is concluded from a critical examination of existing papers interpreting the results of intensity measurements of emission of nitrogen and air plasma, that N^- has an insignificant part in plasma emission. (auth)

34268 OPTICAL DETERMINATION OF Cs GROUND-STATE DEPLETION IN Cs–Ar LOW-PRESSURE DISCHARGES. II. RADIAL AND AXIAL Cs-ATOM DISTRIBUTIONS. Bleekrode, R.; van der Laarse, J. W. (Philips Research Labs., Eindhoven, Netherlands). J. Appl. Phys., 40: 2401-3(May 1969).

The radial and axial distributions of Cs ground-state ($6^2S_{\frac{1}{2}}$) atoms in Cs–Ar low-pressure discharges are studied by absorption spectroscopy. The results show that there is appreciable Cs-atom depletion at the center of the discharge. Within experi-

mental accuracy the Cs($6^2S_{\frac{1}{2}}$) concentration is found to be constant over the whole length of the positive column of the discharge. (auth)

34269 CESIUM DEPLETION IN THE POSITIVE COLUMN OF Cs–Ar DISCHARGES. Waszink, J. H.; Polman, J. (Philips Research Labs., Eindhoven, Netherlands). J. Appl. Phys., 40: 2403-8(May 1969).

The longitudinal electric field and the electron density and temperature have been measured in the positive column of low-pressure dc arc discharges in mixtures of cesium and argon at densities around 5×10^{18} and 5×10^{21} m^{-3}, respectively. The measurements have been made with electrostatic probes and with a microwave interferometer. At a low discharge current, cesium alone is ionized. When the discharge current is increased the cesium atom density is reduced by ionization and radial diffusion, and at a critical current a discontinuous transition to a state having a high electron temperature is observed. This discontinuity is explained as the result of a multivaluedness of the electric field as a function of the current density. Even at the present low degree of ionization, the electron mobility is found to be strongly influenced by Coulomb collisions. (auth)

34270 CALCULATION OF LINE STRENGTHS FOR TRANSITIONS BETWEEN DOUBLY EXCITED STATES AND THE 2 ^{3}S STATE OF HELIUM. Knox, H. O.; Rudge, M. R. H. (Queen's Univ., Belfast). J. Phys., B (London), 2: 521-3(May 1969).

A calculation of wave functions for helium and its isoelectronic series is described. These wave functions were used to make calculations for the line strengths involving transitions connecting the doubly excited series of levels with the 2 ^{3}S state of helium. (auth) (UK)

Positronium, Muonium, and Mesic Atoms and Molecules

34271 BOUND STATES AND THE LADDER APPROXIMATION IN POSITRON ANNIHILATION. Bergersen, Birger (Inst. of Theoretical Physics, Goteborg). Phys. Rev., 181: 499-505 (May 10, 1969).

A discussion is given of the consistency requirements relevant to the calculation of the properties of a positron before annihilating in an electron gas, and, in particular, of the sense in which one can meaningfully speak of positronium-like bound states. It is shown that such states can be explicitly introduced by making an ansatz for them. The annihilation rate computed from this ansatz is, however, somewhat lower than the experimental values. The properties of the ladder approximation are also analyzed, and it is shown that the frequently stated opinion that the divergence of this approximation at sufficiently low densities corresponds to the formation of positronium-like states is incorrect. It is shown that this divergence corresponds to an unphysical instability of the whole system. Some cancellation mechanisms that help to explain the success of the ladder approximation for high and intermediary electron densities are demonstrated. Whenever possible, comparisons are given with the important and similar case of a heavy impurity. (auth)

Collision Phenomena

Refer also to abstracts 34266 and 34549.

34272 (CALT–767-P-4-43) DETERMINATION OF DIFFERENTIAL ELASTIC AND VIBRATIONAL EXCITATION CROSS SECTIONS FOR e–H_2 SCATTERING. Trajmar, S.; Rice, J. K.; Truhlar, D. G.; Brinkmann, R. T.; Kuppermann, A. (California Inst. of Tech., Pasadena). [1968]. Contract AT(04-3)-767. 9p. (CALT–532-43; CONF-690702-4). Dep. CFSTI.

From 6th International Conference on the Physics of Electronic and Atomic Collisions, Cambridge, Mass.

The elastic scattering of electrons by H_2 was studied together with the pure vibrational excitation (rotational levels are not resolved). Angular distributions of the elastically and inelastically scattered electrons causing the fundamental and first and second overtone excitations were measured in the 8° to 80° range. Certain aspects of the experimental procedures and the angular behavior of some of the inelastic-to-elastic scattering intensity ratios (R) at 7- and 60-eV impact energies are presented. (auth)

34273 (CALT–767-P-4-44) MEASUREMENT OF DIFFERENTIAL SCATTERING OF D_2–N_2. Winicur, D. H.; Martin, L. R.; Devereaux, W. R.; Kuppermann, A. (California Inst. of Tech., Pasadena. Arthur A. Noyes Lab. of Chemical Physics). [nd]. Contract AT(04-3)-767. 6p. (CONF-690702–5). Dep. CFSTI.

From 6th International Conference on the Physics of Electronic and Atomic Collisions, Cambridge, Mass.

A crossed-molecular-beam technique was used to measure differential scattering cross sections of $D_2 - N_2$ from 2 to 21° (cms). Small-angle interference oscillations were observed out to 16°. A straight line was fitted to a log-log plot of $d\sigma/d\omega$ vs θ to obtain the average angular dependence of the cross section $d\bar{\sigma}/d\bar{\omega}$. The slope of this line indicated that $d\bar{\sigma}/d\omega \propto \theta^{-4.1}$ below 16°. (A.G.W.)

34274 (CALT–767-P-4-45) CROSS SECTIONS FOR EXCITATION OF THE 2^3S STATE OF HYDROGEN BY ELECTRON IMPACT. Truhlar, D. G.; Kuppermann, A. (California Inst. of Tech., Pasadena. Arthur A. Noyes Lab. of Chemical Physics). [1968]. Contract AT(04-3)-767. 10p. (CONF-690702–2). Dep. CFSTI.

From 6th International Conference on the Physics of Electronic and Atomic Collisions, Cambridge, Mass.

Several different theories and approximations were used to calculate integral and differential cross sections for the 1s – 2s transition in hydrogen excited by electron impact. The results of the various calculations are compared with each other, with other calculations, and with experiment in figures and tables. (A.G.W.)

34275 (CALT–767-P-4-46) ELECTRON SCATTERING BY $X^1\Sigma_g^+H_2$ AT 10 eV WITH EXCITATION OF NUCLEAR MOTION Truhlar, D. G.; Rice, J. K.; Trajmar, S.; Kuppermann, A. (California Inst. of Tech., Pasadena). [1968]. Contract AT(04-3)-767. 12p. (CONF-690702-3). Dep. CFSTI.

From 6th International Conference on the Physics of Electronic and Atomic Collisions, Cambridge, Mass.

Calculations were performed on electron scattering by hydrogen molecules in which the static potential (including the long-range quadrupole interaction), the polarization potential, and electron exchange effects were considered simultaneously. The calculations were performed in the Born and Born–Ochkur–Rudge approximations. New experimental differential cross sections (DCS) for elastic and inelastic scattering are also reported. The present calculations agree better with the experimental elastic DCS than any previous calculations. (A.G.W.)

34276 (NP–17938) THE INTERACTION OF MOLECULES WITH LOW-ENERGY (0 TO 30 eV) ELECTRONS. Brongersma, Hidde Herman (Leiden Rijksuniversiteit (Netherlands)). 1968. 90p. Dep.

Thesis.

Electronic transitions induced by impact of low-energy electrons on a variety of atoms and molecules were studied. A spectrometer particularly suitable for the study of threshold excitations is described. Results are presented and discussed for nitrogen, carbon monoxide, ammonia, saturated hydrocarbons, olefins, molecules containing the carbonyl group, conjugated hydrocarbons, and organic nitrogen compounds. A striking feature of these results is the importance of singlet–triplet and other optically forbidden transitions. Total cross sections for given excitation processes in He, CO, N_2, O_2, CO_2, ethylene, and benzene were measured. (A.G.W.)

34277 (ORO–2911-11) INTERACTION OF HEAVY keV IONS WITH GASES. Progress Report, June 1, 1968–May 31, 1969. Boring, John W. (Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences). June 1969. Contract AT(40-1)-2911. 42p. (EE–3930-106-69-U). Dep. CFSTI.

Progress during the period is summarized on development of a method of measuring total ionization by heavy ions in gases, measurements of differential cross sections for scattering of ions in the keV range, and development of a theoretical description of the differential cross section for charge transfer. Some data on differential cross sections for scattering of H^+ by Ar are presented. A reprint of a published article describing ionization measurements in CO_2, C_2H_4, and C_2H_2 and a preprint of an article on use of the Thomas–Fermi model in analysis of ionization measurements are included as appendices. (A.G.W.)

34278 COMPARISON OF THE CALCULATED AND OBSERVED RESONANCES IN THE e–H ELASTIC-SCATTERING CHANNEL ABOVE 10.0 eV. Ormonde, S. (Quantum Systems, Inc., Albuquerque, N. Mex.); McEwen, J.; McGowan, J. William. Contract No. AF29(601)-68-C-0052. Phys. Rev. Lett., 22: 1165-7(June 2, 1969).

A wide structure observed experimentally in the elastic cross section for electron–hydrogen-atom scattering below the n = 2 threshold is analyzed using close-coupling calculations. Good agreement with experiment is found for the six-state approximation. (auth)

34279 SCATTERING OF K AND Cs BY SEVERAL COMPOUNDS. Greene, E. F. (Brown Univ., Providence); Hoffman, L. F.; Lee, M. W.; Ross, J.; Young, C. E. J. Chem. Phys., 50: 3450-61(Apr. 15, 1969).

The nonreactive scattering of K from $C_{10}H_{16}$, $(CH_3)_3CBr$, $SiCl_4$, Cl_2, Br_2, I_2, ICl, $(CN)_2$ C = C$(CN)_2$, and Cs from HBr has been

studied in experiments with crossed molecular beams. The primary alkali metal beam was velocity selected, and the scattered alkali metal was measured as a function of laboratory angle at a number of initial relative kinetic energies. Potential parameters are calculated from the rainbow scattering for K + $C_{10}H_{16}$, $(CH_3)_3CBr$, $SiCl_4$, and Cs + HBr and also from the supernumerary rainbows for K + $C_{10}H_{16}$ and $(CH_3)_3CBr$. An optical model analysis on K + $(CH_3)_3CBr$ and Cs + HBr yields information about threshold conditions for reaction, probability of reaction, and total reaction cross section as a function of relative energy. For systems without rainbow scattering [K + halogens, $(CN)_2C = C(CN)_2$] an optical analysis made with a simple form for the absorption function requires a gradual change from a van der Waals potential at very large distances of separation of reactants to a more attractive potential at smaller distances. This indicates a gradual electron transfer on approach of reactants rather than an abrupt electron jump. (auth)

34280 COLLISION-INDUCED DISSOCIATION OF H_2^+ IONS ENERGY AND ANGULAR DEPENDENCE. Meierjohann, B.; Seibt, W. (Univ., Giessen, Ger.). Z. Phys., 225: 9-25(1969). (In German).

Inelastic collisions between the hydrogen molecule ion and the hydrogen molecule leading to dissociation are investigated experimentally in the energy range between 3 and 20 keV. The velocity distributions of the protons produced in these processes are compared with calculated distributions using a Born approximation formula. The calculation takes into account the excitation of the $2p\sigma_u$ state of the H_2^+ and a possible simultaneous excitation of the target. It can be shown that the quantitative knowledge of these processes makes possible a satisfying explanation of the measured distributions. In general a good agreement is obtained between theory and experiment concerning both energy and angular dependence of the velocity distributions. (auth)

34281 RETARDATION EFFECTS IN SECOND-ORDER RADIATIVE TRANSITIONS BETWEEN HYDROGENIC STATES. Klarsfeld, S. (Institut de Physique Nucleaire, Orsay, France). Nuovo Cim., Lett., 1: 682-6(May 11, 1969).

A closed-form expression, including retardation effects, for the second-order matrix element describing radiative transitions between two arbitrary bound S states is obtained by analytic methods. The expression is applied to the special cases of Rayleigh scattering, Raman scattering, and elastic scattering. (A.G.W.)

34282 A NOTE ON A RELATIVISTIC FORMULA FOR IONIZATION BY PROTON IMPACT. Chowdhury, A. Roy (Jadavpur Univ., India). Indian J. Phys., 42: 444-6(July 1968).

The ionization process in the collision of a proton with a hydrogen-like atom is considered, neglecting the translatory motion of the nucleus. The formulae development starts with the initial bound-state wave function of Roy (Z. Phys., 158: 142(1960)); subsequently, the matrix element and differential cross section for the process are formulated. The formula for the cross section is easily reducible to that of the usual Born approximation results in the nonrelativistic limit. (L.M.T.)

34283 EXCITATION INDUCED BY 0.15 TO 1.0-MeV PROTONS IN ARGON. Thomas, E. W. (Georgia Inst. of Tech., Atlanta). J. Phys., B (London), 2: 625(May 1969).

The spectrum emitted as a result of proton impact on an argon target was investigated, and cross sections were determined for the collisionally induced emission of the 4200-Å Ar I line and the 4431-Å Ar II line. The cross section for the 4431-Å line is 8.0×10^{-20} cm^2 at 150 keV and decreases linearly with increasing energy. The 4200-Å emission has a cross section of similar magnitude, but decreases less rapidly with energy. (auth) (UK)

34284 SCATTERING OF X RAYS BY HYDROGEN ATOMS. Gorshkov, V. G.; Polikanov, V. S. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR) (Engl. Transl.), 9: 279-82 (Apr. 20, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 9: 464-8(Apr. 20, 1969).

Formulas are obtained for the scattering of photons by hydrogen atoms at the frequency ω, including frequencies on the order of the average electric momentum in the atom $\eta = m\alpha Z$ ($\hbar = c = 1$). Arbitrary transitions between the atomic shells, including ionization, are considered. (M.O.W.)

34285 FRAGMENTATION OF MOLECULAR GASES BY 5 TO 45 keV He^+ IONS. Browning, R.; Latimer, C. J.; Gilbody, H. B. (Queen's Univ., Belfast). J. Phys., B (London), 2: 534-40(May 1969).

Ionization and fragmentation by 5- to 45-keV He^+ ions during passage through thin targets of H_2, N_2, O_2, CO, CO_2, and CH_4 were investigated by mass spectrometric analysis of the secondary ionic products of single collisions. The method ensured that all secondary product ions were collected and recorded with high and uniform efficiency. Fragmentation processes were found to play a dominant role in secondary ion production for all the cases considered. Below about 15 keV, it is shown that charge transfer takes place mainly through dissociative processes. Dissociative ionization is also shown to be significant, particularly for targets of H_2, N_2, and O_2, at unexpectedly low impact energies. The energy dependence of the various cross sections for the production of fragment ions is not at all in accord with the predictions of the simple adiabatic maximum rules. (auth) (UK)

34286 EXCITATION OF O_2^+ BANDS BY ELECTRON IMPACT. McConkey, J. W.; Woolsey, J. M. (Queen's Univ., Belfast). J. Phys., B (London), 2: 529-33(May 1969).

Absolute excitation cross sections for the emission of the first negative bands of O_2^+ under electron impact on O_2 were obtained. The peak cross section for the b $^4\Sigma_g^-$ state was found to be 32.5×10^{-18} cm^2 at 100 eV. The results are compared with proton and other electron impact data. Some preliminary results on the second negative system are also given. (auth) (UK)

Cosmic Radiation

Refer also to abstracts 34229, 34242, 34519, 34520, 34530, 34577, and 34580.

34287 (AECL-3282) COSMIC RAY NM-64 NEUTRON MONITOR DATA FROM KULA, HAWAII. Carmichael, H.; Steljes, J. F.; Kowalski, A. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Jan. 1969. 46p. Dep. CFSTI. CAN $1.50.

Uncorrected and barometer-corrected hourly data from a 3-NM-64 mobile latitude survey neutron monitor stationed at Kula, Maui, Hawaii are given in tabular form for the period from January 1968 to December 1968. Graphs of the corrected data and of the barometric averages are given for the same period. The site is about 1000 m above sea level and the data are corrected to 68.6 cm Hg. (auth)

34288 CONCERNING THE NATURE OF THE COSMIC ISOTROPIC X RADIATION. Rozental, I. L.; Shukalov, I. B. JETP Lett. (USSR) (Engl. Transl.), 9: 183-4(Mar. 5, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 9: 312-14(Mar. 5, 1969).

The entire spectrum of the isotropic x radiation was examined. The inverse Compton effect of the metagalactic electrons was used in the analysis. (M.O.W.)

34289 SOMETHING NEW IN COSMIC RAYS. Glashow, S. L. (Harvard Univ., Cambridge, Mass.). Acta Phys. Austr., Suppl. 5, 469-76(1968).

From 7th International Proceedings of Particles, Currents, Symmetries, Schladming, Austria. See CONF-680217.

A recent experiment is described in which energetic cosmic radiation found deep in mines is observed. In this experiment the sec θ law was observed to fail. Various explanations for this experiment are described and evaluated. Among these explanations the existence of cosmic particles (thus far unobserved) is postulated, and the properties of these particles are described. (J.F.P.)

34290 COSMIC-RAY ANISOTROPIES AS A FUNCTION OF TIME AND DIRECTION. Ables, J. G. (Univ. of Adelaide). Proc. Astron. Soc. Aust., 1: 114-15(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

The cosmic-ray flux in the energy range 100 MeV/N $\leq E \leq$ 1 GeV/N is remarkable for its high degree of isotropy. The mechanism responsible for this isotropy is presumed to be multiple, large-angle scattering of the charged cosmic particles by irregularities of the interplanetary magnetic field. While generally precluding any hope of discovering a source-related anisotropy of the flux in this energy range, it is just this strong interaction of the cosmic rays with the interplanetary medium that allows the study of the small observed anisotropies, both persistent and transient, to yield considerable information about the structure of the interplanetary medium (the solar wind and its entrapped magnetic field). (W.D.M.)

34291 ASTROPHYSICAL ASPECTS OF COSMIC-RAY RESEARCH AT HOBART. Fenton, A. G.; Fenton, K. B. (Univ. of Tasmania, Hobart). Proc. Astron. Soc. Aust., 1: 113-14(Feb. 1968).

From 2nd Meeting of the Astronomical Society, Canberra, Australia. See CONF-671141.

Using a network of ground-based stations stretching from Lae, New Guinea, to the Antarctic, and high-altitude balloons and rockets, the Hobart cosmic-ray group is studying several aspects of naturally occurring high-energy radiation. A brief discussion of the various phenomena involved is given. (W.D.M.)

34292 EMERGING THEORIES OF THE SOLAR MODULATION OF COSMIC RAYS. Gleeson, L. J. (Monash Univ., Clayton, Victoria). Proc. Astron. Soc. Aust., 1: 130-2(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

This review is concerned mainly with the solar modulation of galactic cosmic rays and the progress that has been made since the Tenth International Conference on Cosmic Rays (Calgary, June 1967). Some of the advances in the basic theories are set out and it is indicated why certain disagreements between convection–diffusion theory and observations are to be expected. Some of the currently emerging areas of interest are discussed. (W.D.M.)

34293 EQUILIBRIUM SPECTRA OF SECONDARY COSMIC-RAY POSITRONS IN THE GALAXY AND THE SPECTRUM OF COSMIC GAMMA RAYS RESULTING FROM THEIR ANNIHILATION. Stecker, F. W. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. Space Sci., 3: 579-99(Apr. 1969).

A general formula is derived for calculating the γ-ray spectrum resulting from the annihilation of cosmic-ray positrons. This formula is used to calculate annihilation-γ-ray spectra from various equilibrium spectra of secondary galactic positrons. These spectra are then compared with the γ-ray spectra produced by other astrophysical processes. Particular attention is paid to the form of the γ-ray spectrum resulting from the annihilation of positrons having kinetic energies below 5 keV. It is found that for mean leakage times out of the Galaxy of less than 400 million years, most of the positrons annihilating near rest come from the β-decay of unstable nuclei produced in cosmic-ray p–^{12}C, p–^{14}N, and p–^{16}O interactions, rather than from pi-meson decay. It is further found that the large majority of these positrons will annihilate from an S state of positronium and that $\frac{3}{4}$ of these will produce a three-photon annihilation continuum rather than the two-photon line spectrum at 0.51 MeV. The results of numerical calculations of the γ-ray fluxes from these processes are given. It is concluded that annihilation γ rays from the galactic halo may remain forever masked by a metagalactic continuum. However, an 0.51 MeV line from the disk may well be detectable. It is most reasonable to assume that this line is formed predominantly by the annihilation of the CNO β-decay positrons. Under this assumption, the intensity of the line becomes a sensitive measure of the galactic cosmic-ray flux below 1000 MeV/nucleon. (auth)

34294 HIGH-ENERGY COSMIC-RAY MUONS FROM A WEAK INTERACTION. Campbell, J. A. (Flinders Univ., Bedford Park, South Australia). Proc. Astron. Soc. Aust., 1: 153-4(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

A recent measurement of muon flux at energies greater than 10^{12} eV provides evidence for muon production by a process other than pion decay in cosmic-ray showers. Near this characteristic energy, the existing theory of weak interactions requires modification if it is not to violate a limitation imposed by unitarity, which represents the conservation of probability. This work is an examination of modifications that are needed if the framework of the theory is to be retained. (W.D.M.)

34295 A NEW DETERMINATION OF MUON DIRECTIONAL COUPLING COEFFICIENTS. Cooke, D. J.; Fenton, A. G. (Univ. of Tasmania, Hobart). Proc. Astron. Soc. Aust., 1: 154-7(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

Incomplete knowledge of the muon coupling coefficients is holding back in some major respects the progress in detailed interpretation of cosmic-ray telescope data. Theoretical estimates of the coefficients prove inordinately difficult at all but high momenta, and the experimental determinations to date for low values of momentum (involving correlation of observed muon intensity with the calculable primary cutoff momenta in the geomagnetic field) fail to agree satisfactorily. In an attempt to resolve this situation, a new determination of the low-momentum coefficients was made, employing techniques in the analysis designed to avoid the difficulties encountered in earlier estimates. The preliminary results of this work are reported briefly. (W.D.M.)

34296 CORRELATION BETWEEN THE COSMIC-RAY SOLAR DAILY VARIATION UNDERGROUND AND GEOMAGNETIC ACTIVITY. Fenton, A. G. (Univ. of Tasmania, Hobart). Proc. Astron. Soc. Aust., 1: 149-50(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

Since 1957, the University of Tasmania has operated cosmic-ray-meson telescopes at an underground site near Hobart for the purpose of monitoring the intensity variations in the high-energy component of the primary flux near the Earth. The results for the period 1959–1966 are given and their significance is discussed briefly. (W.D.M.)

34297 AN ANOMALOUS FORBUSH DECREASE. Humble, J. E. (Univ. of Tasmania, Hobart). Proc. Astron. Soc. Aust., 1: 146-8(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

A quiet period following Nov. 25, 1960, was interrupted by a magnetic sudden commencement at 1915 UT on Nov. 30. About 3 hours later, during H23, neutron monitors looking in the directions between 00h and 09h LT (180° to 50° west of the Earth–Sun line) observed a decrease ranging in amplitude up to 5.9%. The decrease was seen for about 5 to 6 hours by stations looking at the appropriate directions. The event was unusual in that it provided the typical sharp predecrease which can occur a few hours prior to a Forbush decrease, without the expected F.D. subsequently occurring. (W.D.M.)

34298 CORRECTIONS TO TWO PREVIOUS ARTICLES ON EXTRAGALACTIC GAMMA RAYS AND IMPLICATIONS OF THE CORRECTED RESULTS. Stecker, F. W. (Goddard Space Flight Center, Greenbelt, Md.). Nature (London), 222: 1157-8(June 21, 1969).

Corrections are presented concerning the Author's communications in Nature 220: 675(1968) and 221: 425(1969); these corrections affect metagalactic cosmic-ray intensities and give the power-law spectra steeper slopes. (UK)

34299 DETECTION OF HIGH-ENERGY GAMMA RAYS FROM THE GALACTIC DISK AT BALLOON ALTITUDES. Sood, R. K. (Imperial Coll. of Science and Tech., London). Nature (London), 222: 650-2(May 17, 1969).

The only positive evidence so far obtained for the presence of extraterrestrial gamma radiation of energy >50 MeV was obtained by OSO III satellite experiments. Measurements revealed a significant flux of gamma rays associated with the galactic plane, with an enhancement in the direction of the galactic center. It is not known whether this flux comes from a number of unresolved sources, collisions between cosmic-ray protons and interstellar hydrogen, or Compton collisions between cosmic-ray electrons and the high-intensity infrared radiation background. Attempts to detect the radiation by balloon experiments have suffered from a high level of locally generated background. This communication describes results obtained from a number of balloon flights in 1967 and 1968 from Kampala, Uganda, carrying gamma-ray detectors designed primarily to search for π^0-decay gamma rays from the Sun. In order to minimize background the flights were near the geomagnetic equator, and the detector was carefully designed to reject spurious events simulating gamma rays. Details are given of the special type of detector employed. The efficiency of conversion of the incident gamma rays into electron-positron pairs was calculated as 38% for energies >50 MeV. Means were incorporated to eliminate shower particles triggering the gamma-ray channel, and the detector had a low sensitivity to the relatively high horizontal gamma-ray flux generated by the Earth's atmosphere. The balloons floated at an altitude of 4 to 6 mbar for 7.5 to 11 hr. Results are shown graphically, and extrapolation to the top of the atmosphere corresponded to a primary flux of $5 \pm 0.6 \times 10^{-4}$ photons/cm^2/sec/sr. Indications of an enhanced γ-ray flux from the galactic disk were observed on each flight. Comparisons are made with OSO III data. The feasibility of investigating extraterrestrial gamma rays using balloon techniques was demonstrated. The gamma-ray intensities measured appear to be greater by a factor of about 10 than expected on the basis of cosmic-ray interactions with interstellar hydrogen. (UK)

34300 COSMIC-RAY HEAVY-NUCLEUS ENDERS AT VARIOUS ATMOSPHERIC DEPTHS. Fukui, K. (Air Force Cambridge Research Lab., Bedford, Mass.).; Lim, Y. K.; Young, P. J. Nuovo Cim., 61B: 210-19(June 11, 1969).

The increased ionization of a heavy cosmic-ray nucleus near the end of its range can cause the deposit of radiation dosage as high as several thousand rads along its trajectory. Although the biological significance of such radiation is still not well understood, it is of interest to know the intensity of stopping heavy nuclei at altitudes where supersonic transports are expected to operate. The flux of enders of charges $Z \geq 6$ in nuclear emulsions was obtained for three balloon flights during 1965-1966 at atmospheric depths 3, 38, and 58 g/cm^2. It was found that the flux of enders incident from a particular zenith angle is a function of the path length from the top of the atmosphere. The number of heavy-nucleus enders encountered at the supersonic transport flight level of (60,000 to 70,000) feet is calculated to be only a few percent of the number that would be encountered on top of the atmosphere for the same duration. (auth)

34301 PHYSICAL BASIS OF THE TRANSPORT AND COMPOSITION OF COSMIC RAYS IN THE GALAXY. Gloeckler, G. (Univ. of Maryland, College Park); Jokipii, J. R. Phys. Rev. Lett., 22: 1448-53(June 30, 1969).

Consideration of cosmic-ray propagation leads naturally to an equilibrium model for cosmic-ray origin and storage in the galaxy. In this model the relative abundances of nuclei with substantially different charge values are nearly energy-independent. It is concluded that this simple, one-"component" model is consistent with observations of both the galactic primary (i.e., ^{1}H, ^{4}He, C, N, O, Fe) and secondary particles (^{3}He, Li, Be, B). (auth)

34302 POSSIBLE ORIGIN OF THE DIFFUSE COMPONENT OF COSMIC X RAYS. O'Connell, R. F.; Verma, S. D. (Louisiana State Univ., Baton Rouge). Phys. Rev. Lett., 22: 1443-5(June 30, 1969).

It is shown that if one assumes (following Cowsik and Pal and Shen in their explanation of the flux of galactic gamma rays) that the recently measured far-infrared radiation is galactic, then one must also accept the existence of the x-ray flux, with a magnitude in agreement with observations but with a large anisotropy, in sharp disagreement with the measured isotropy. (auth)

Direct Energy Conversion

34303 (JUL-553-TP) ENERGY CONVERSION WITH THERMIONIC DIODES. Bundschuh, V.; Butz, R.; Claassen, H. A.; Krahl-Urban, B.; Niekisch, E. A.; Preuss, E. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Technische Physik). Oct. 1968. 92p. (In German). (CONF-681050). Dep.

From Conference on the Status of Thermionic Research, Julich, Germany.

Six papers presented at a seminar on the state of thermionic research at the Institut fuer Technische Physik on October 10, 1968, are compiled. The topics discussed are the efficiency of thermionic diodes as energy converters and their technical significance, the operational behavior of thermionic diodes in the "arc mode," optimization of thermionic diodes with respect to technical parameters, effects of the basic work function of the emitter, the emitter temperature, and the minimum collector work function on the efficiency and optimum electron gap of a cesium diode, preparation of emitter surfaces with high work function and their applicability in thermionics, and nuclear fuel material for nuclear-heated emitters. (J.S.R.)

34304 CHARACTERISTICS OF A FINITE-LENGTH MHD TRAVELING-WAVE CYLINDRICAL ACCELERATOR OR GENERATOR. Jester, Jerry L.; Fanucci, Jerome B. (West Virginia Univ., Morgantown). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 7: 864-70(May 1969).

Previous work in MHD ac electrodeless generators has shown that a major portion of the losses are due to fringing effects related to the small number of wavelengths of the device. This theoretical study determines quantitatively the electrical efficiency of a cylindrical accelerator or generator of length comprising any integral or fractional number of wavelengths of the primary coil windings. The analysis employs the classical MHD equations and takes advantage of the usual simplifying assumptions. In the second part of the paper, a solution is presented which determines the correction coils necessary to eliminate first-order fringing losses. It has been found that, if the phase velocity of the magnetic field is greater than the fluid velocity, i.e., an accelerator, fringing may cause the device to act as a Joule heater rather than an accelerator. Indeed, for very small slips, most of the energy goes into Joule heating. For negative slip the device is a true generator, except for a region where the slip is small. Performance maps are presented which show, for a given radius and length, the electrical efficiency of the device as a function of the slip, whether it behaves as an accelerator, a Joule heater, or a generator. Numerical results also are shown for the aforementioned maps when correction coils are employed to eliminate first-order fringing losses in the device. (auth)

34305 THEORETICAL PERFORMANCE OF A FARADAY-TYPE GENERATOR WITH NONEQUILIBRIUM IONIZATION IN THE CONVERSION GAS. Petit, Jean-Pierre (Aix-Marseille Univ., Marseille). Compt. Rend., Ser. A, 268: 835-8(Apr. 14, 1969). (In French).

The important role of the charge factor in nonequilibrium ionization processes for a Faraday-type generator in the conversion gas was indicated in experimental results in a previous note (Compt. Rend., Ser. A, 268: 245(1969)). The calculation of the theoretical performance in this note specifies this role. (J.F.P.)

34306 DIAGONAL-CONDUCTING-WALL MHD GENERATOR CHANNEL FLOWS. Shanklin III, Richard V. (J. B. Dicks and Associates Inc., Tullahoma, Tenn.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 7: 975-6(May 1969).

The flow formulation presented in this note is, in form, identical to certain "classical" MHD channel flows. The formulation permits an easy flow analysis and includes Hall effect, electrode drop, and electrode wall angle. (L.M.T.)

34307 GEOMETRY-INDEPENDENT OPTIMIZATION OF THERMOELECTRIC CONVERSION SYSTEMS. Zahn, P. (Messerschmitt-Boelkow GmbH, Munich). Energy Convers., 9: 67-72(June 1969). (In German).

The utilization of the relationship between reduced parameters enables the methods of calculation to be simplified and the yield of systems of thermoelectric conversion to be improved, especially as far as multi-stage control equipment is concerned. The optimum ratio "electric current to flow of energy" is confirmed as a parameter characteristic of the material, signifying the lack of electrical adaptation for each interval of temperature. This method is applied to several kinds of multi-stage converters activating the semiconductors PbTe and GeSi. (auth) (UK)

Fluid Physics

Refer also to abstract 34306.

34308 (AD-683133) STUDY OF VARIOUS METHODS OF DETERMINING THE TEMPERATURE OF A PLASMA IN A MHD DUCT. Suckewer, S.; Licki, J.; Mizera, B.; Zelazny, P. Translation of a Monograph. 22p. (FTD-MT-24-178-68). CFSTI.

The temperature of a plasma consisting of combustion products in an MHD duct was measured by a number of different methods: absolute spectral line intensity recording; sodium line reversal; a generalized method of spectral line inversion; and dynamic thermocouple. The experimental setup consisted of an oxy-acetylene combustion chamber and a small MHD duct. The conditions under which the measurements were made were similar to those in large experimental facilities. Using the above methods, the authors compared the results of simultaneous temperature measurements for different combustion chamber operating conditions depending on the amount of line indicator and the quantity of seed. By measuring the temperature in a given region of the plasma by the generalized method of the sodium line reversal and by means of a dynamic thermocouple it was possible to estimate the accuracy of the thermocouple. With the help of the dynamic thermocouple the temperature was also determined as a function of distance from the duct axis. In order to compare the accuracy of the spectral methods of temperature measurement, the authors examined spectrograms obtained in the 4000- to 7000-A region and measured the spectral line contours by means of a Fabry–Perot interferometer. (USGRDR)

34309 (IPP-3/63) EXPERIMENTAL INVESTIGATION OF CURRENT DENSITY DISTRIBUTIONS AND RELAXATION EFFECTS IN AN ARGON–POTASSIUM PLASMA STREAMING THROUGH A CHANNEL WITH SEGMENTED ELECTRODES. Dodel, G. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Nov. 1967. 55p. (In German). Dep.

Electron-temperature distributions were measured in an argon–potassium plasma streaming through a channel with segmented electrode array (similar to that of a Faraday-type MHD generator) to provide information about the relevant current distributions. The interpretation of the measurements is based on the energy equation of the electrons, which is discussed for the case where relaxation effects and electron temperature gradients occur. A calculated model shows that relaxation effects of the electron density are indeed significant under present conditions and may cause considerable deviations of the local electron density from the relevant Saha values. Though this appreciably complicates quantitative interpretation of the electron-temperature measurements, it was possible to determine essential qualitative features of the current distribution in a duct with segmented electrodes. Measurements with and without magnetic field were made under nonperiodic conditions, i.e., with only one or a few electrode pairs in operation, as well as under approximately periodic conditions, i.e., with so many electrode pairs in operation that the electrodes at both ends of the electrode array no longer influenced the measuring area. A number of experimental results, especially in the nonperiodic case, indicated considerable influence of relaxation effects. In the periodic case, the experimental results could be compared with calculated current distributions. Qualitative agreement was found. In the central region of the duct the direction of the current density could be concluded from an electron temperature difference observed between the values measured with and without magnetic field. At the electrodes the electron temperature profile depended on whether the electrode was anode or cathode. At the anode a strong influence of the plasma flow ve-

locity on the electron temperature profile could be observed and explained by relaxation effects. The electron temperature distributions were determined by intensity measurements of the potassium resonance radiation. Relaxation effects of the resonance light could be shown to be insignificant under present conditions. In the appendix, the radial dependence of the local energy loss by resonance radiation is investigated for a plasma cylinder. (auth)

34310 PROBLEM OF THIN PROFILES IN MAGNETOAERODYNAMICS. Dragos, Lazare (Univ., Bucharest). Compt. Rend., Ser. A, 268: 831-4(Apr. 14, 1969). (In French).

Starting from the equation of motion for a compressible fluid with electric resistivity different from zero in the presence of a thin profile, it is shown that in supersonic flows as well as subsonic flows, the problem is solved by Fredholm-type integral equations. (J.F.P.)

34311 STUDY OF THE ELECTROHYDRODYNAMIC FLOW AT HIGH REYNOLDS NUMBERS. Gogosov, V. V.; Polyanskii, V. A.; Semenova, I. P.; Yakubenko, A. E. Zh. Prikl. Mekh. Tekh. Fiz., No. 1, 3-10(Jan.-Feb. 1969). (In Russian).

The motion of a medium consisting of neutral particles and charged particles of the same sign was investigated, assuming that the electric Reynolds' number, $R_E = U/bE$, is large. The electrohydrodynamic equations derived by O. M. Stuetzer are greatly simplified when the electric Reynolds' numbers are low, i.e.; when the mobility assumes low values. The basic equations are derived, calculating the Bernoulli and Cauchy–Lagrange integrals. The motion of an ideal, non-heatconducting liquid in a thin tube was examined, assuming that the flow rate and the cross section of the tube are uniform and the interaction coefficient is small. When studying the flow of a viscous, compressible, electrically conducting liquid at a high electric Reynolds' number, the viscosity and heat conductivity must be taken into account in the thin boundary layer, in which the flow rate and the temperature undergo sudden changes. (TTT)

34312 A METHOD FOR CALCULATING THE GASDYNAMIC AND ELECTRIC PARAMETERS OF THE TWO-DIMENSIONAL FLOW OF LOW-TEMPERATURE PLASMA IN A COAXIAL MAGNETOGASDYNAMIC CHANNEL. Vysotskaya, I. V.; Grishin, A. V.; Dodotchenko, V. V. Zh. Prikl. Mekh. Tekh. Fiz., No. 1, 129-35(Jan.-Feb. 1969). (In Russian).

The effect of the transversal nonhomogeneity of the magnetic field, the variable conductivity of the plasma, and the dependence of the Hall parameter on the magnetic field and pressure was studied, examining also the gas-dynamic and electric parameters of the two-dimensional flow of a conducting gas in the coaxial channel of a magnetogasdynamic generator. In view of the transversal nonhomogeneity of the magnetic field, the flow in the channel had to be solved on a two-dimensional basis. The dependence of the current density factors and of the axial velocity on the radius was analyzed. It was found that at the input end of the channel, part of the Hall currents is opposed to the Faraday currents; at the output end, the two coincide. If a certain Hall number is exceeded at the inner electrode, the longitudinal component of the velocity is strongly increased, resulting in anodic oscillations. (TTT)

Geophysics (Upper Atmosphere)

34313 (AD-684322) IONOSPHERIC D-REGION PARAMETERS FROM BLUNT PROBE MEASUREMENTS DURING A SOLAR ECLIPSE. Final Report (Part B). Report No. Scientific-334. Baker, Duncan C. (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). Feb. 1, 1969. Contract DAAD05-67-C-0005. 110p. CFSTI.

A series of four rocket experiments were performed during the solar eclipse of November 12, 1966, at Cassino, Brazil, to determine the positive and negative conductivities of the atmosphere below 80 km. The conductivity data was interpreted in terms of positive and negative ion and electron densities. The density data was used with the positive ion continuity equation to determine the ion–ion recombination coefficient. (auth) (USGRDR)

34314 LYMAN-ALPHA SCATTERING AND THE SOLAR WIND. Campbell, J. A. (Flinders Univ., Bedford Park, South Australia). Proc. Astron. Soc. Aust., 1: 157-8(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

The Earth is surrounded by a neutral hydrogen envelope, the geocorona. In volumes traversed by the solar wind's protons, the charge-exchange reaction $p + H \rightarrow H + p$ is sufficient to remove any neutral H. Thus hydrogen remains only in regions inaccessible to the solar wind. Since this is a strong argument for the identity of the magnetosphere and the geocorona, an analysis of a process which depends on the shape of the geocorona may also be expected to provide information about the magnetospheric boundary. One such process discussed is the scattering of solar Lyman-α radiation into the antisolar part of the geocorona, which is screened from the Sun by the Earth. (W.D.M.)

34315 OBSERVATIONS OF IONOSPHERIC MOVEMENTS BY THE USE OF A LARGE AERIAL ARRAY. Briggs, B. H. (Univ. of Adelaide). Proc. Astron. Soc. Aust., 1: 150-1(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

When a radio wave is reflected from the ionosphere, a random diffraction pattern is formed over the ground. Simple arguments can be used to show that this pattern will move over the ground with a velocity which is twice the horizontal velocity of the ionosphere. This phenomenon can be used for the detection of movements taking place in the ionosphere. A method of observation is described in which the radio diffraction pattern is sampled at 89 points and converted into a visible pattern. The sampling is achieved by the use of an array of 89 radio aerials arranged in a diamond pattern. (W.D.M.)

34316 ASYMMETRIC PLASMA EXPANSION FROM THE STARFISH EXPLOSION. Edwards, P. J.; Entwistle, R. F. (Univ. of Otago, New Zealand). Proc. Astron. Soc. Aust., 1: 151-2(Dec. 1968).

From Conference on Solar System Plasmas and X-Ray Astronomy, Adelaide, Australia. See CONF-680837.

Observations of delayed gamma radiation from Starfish carried out from a balloon by the Hobart Cosmic-ray Group are interpreted and it is concluded that a large fraction of the hot plasma produced in the explosion was not magnetically confined but instead expanded anisotropically in the form of a 1000 km/sec jet at least 1.5 R_E long into the southern hemisphere. (W.D.M.)

34317 GENERATION OF AN ARTIFICIAL AURORA. Hess, Wilmont N. (Manned Spacecraft Center, Houston, Tex.). Science, 164: 1512-13(June 27, 1969).

On January 26, 1969 an Aerobee 350 rocket was fired from Wallops Island, Virginia, carrying an electron accelerator. Above 230 kilometers the electron guns put out a beam of 0.5 ampere of 10 keV electrons in pulses of 1-second duration aimed downward along the Earth's magnetic field lines. The interaction of electron beam with the atmosphere at an altitude of about 100 kilometers generated enough light so that the auroral rays produced could be photographed on the ground by television camera systems. (auth)

34318 SPECTROSCOPIC STUDY IN THE VISIBLE AND NEAR-ULTRAVIOLET REGIONS OF AURORAE OF NOVEMBER 19, 1966 AND FEBRUARY 4, 1967. Malbrouck, R.; Duysinx, R. (Univ., Liege). Bull. Soc. Roy. Sci. Liege, 38: 35-42 (1969). (In French).

Photoelectric spectra of pulsating aurorae were recorded. Various intensity ratios were obtained. From the v'' progressions, the problem of atmospheric opacity below 4000 A is considered. The values point to much higher absorption than accepted for astronomical observation and may be due to abnormal ozone concentrations. (auth)

34319 CHARACTERISTICS OF THE UPPER ATMOSPHERE DURING A POLAR AURORA. Gerard, J. C. Bull. Soc. Roy. Sci. Liege, 38: 61-71(1969). (In French).

A description is given of the processes of ionization, recombination, and charge transfer affecting the upper atmosphere during an aurora. The relations describing the concentration in ions and electrons are established in the case of quasi-equilibrium. The results obtained are illustrated for a typical aurora of I.B.C. III intensity. Finally, the approximations used in the calculation are discussed in the light of the results. (auth)

34320 PHYSICS OF GEOMAGNETIC PHENOMENA. VOLUME I. Matsushita, S.; Campbell, Wallace H. (eds.). International Geophysics Series. Volume 11-1. New York, Academic Press Inc., 1967. 639p. $27.00.

This text presents the observational features and theoretical interpretations of the geomagnetic field and the influence of this field on the Earth's upper atmosphere and magnetosphere. The individual chapters are integrated to form a primary text for the field. This two-volume work is a summary of the present state of knowledge of the Earth's magnetic field. Topics covered in Volume I include a perspective, instruments and geomagnetic stations, geomagnetic indices, paleomagnetism, main geomagnetic field, electromagnetic induction within the Earth, solar-quiet and lunar-daily variation fields, geomagnetic variations in the equatorial zone, the neutral atmosphere and the quiet ionosphere, the equatorial ionosphere, and temperate-latitude sporadic E. (W.D.M.)

34321 PHYSICS OF GEOMAGNETIC PHENOMENA. VOLUME II. Matsushita, S.; Campbell, Wallace H. (eds.). International Geophysics Series. Volume 11-2. New York, Academic Press Inc., 1967. 789p. $29.00.

Topics included in Volume II include ionospheric disturbances, aurorae, geomagnetic disturbances and storms, geomagnetic pulsations, hydromagnetic waves, satellite and rocket observations, magnetosphere and radiation belts, geomagnetic storms and aurorae, disturbance of the geomagnetic field by the solar wind hydromagnetic model of geomagnetic storms and aurorae, solar wind–magnetosphere interactions, interplanetary magnetic-field model, and the Dst main phase and certain associated phenomena. (W.D.M.)

34322 IONOSPHERIC EFFECT CAUSED BY CELESTIAL X RAYS. Edwards, P. J. (Univ. of Otago, Dunedin, N. Z.); Burtt, G. J.; Knose, F. Nature (London), 222: 1053-4 (June 14, 1969).

An enhancement of the nocturnal D-region conductivity was detected, believed to be caused by x radiation from the strong x-ray source Scorpius XR-1 and other weaker sources in the vicinity of the galactic center. During the night, the electron density in the upper D region is some two orders of magnitude lower than during the day, and is presumably maintained, in quiet conditions, by cosmic rays, celestial x rays, and hydrogen Lyman-α radiation. It was calculated that the ionization due to Sco XR-1 exceeds that due to the galactic cosmic radiation or the celestial x-ray background at altitudes of 80 to 90 km. Ionization due to Lyman-α radiation appears to be about one-half that due to Sco XR-1. The conductivity may increase by as much as 50% due to Sco XR-1 at 80 to 85 km., and the effect on the phase of vlf ratio waves is considered. (UK)

34323 TOPSIDE IONOSPHERIC STRUCTURE AT NORTHERN MIDLATITUDES AFTER GROUND SUNSET IN SUMMER. Arendt, P. R.; Soicher, H. (Army Electronics Command, Fort Monmouth, N. J.). Nature (London), 222: 1155-6(June 21, 1969).

Ionograms recorded during a south-to-north passage of Alouette I shortly after ground sunset, but during ionospheric sunset, were analyzed for a magnetically quiet period in July 1966, and a plot of electron density at fixed altitudes versus latitude for an orbit taken during topside and bottomside ionospheric sunset showed a typical latitudinal topside structure. The trend at lower altitudes indicated a decrease in electron density at fixed heights as the satellite moved northwards, whereas at higher altitudes an increase was indicated. In the vicinity of 700 km, the density was constant for the latitudinal range considered. A similar trend was shown in other observations under equal conditions. The contour trend changed at all altitudes at nearly the same geographic latitude where the sunset line reached about 300 km, suggesting that illumination at h_{max} might influence the electron density structure at all other topside altitudes. Details are also given relating to a control orbit when the entire atmosphere and ionosphere were illuminated at all latitudes north of 40°. A general decrease in density was observed at all altitudes up to ~55°N lat., from which position there was an increase at all heights as the satellite entered the auroral regions. The topside regions must have been thermally stable since they were illuminated during the long summer day. The observations suggest that denser upper regions must have existed in the northern latitudes during this period. The possibility of direct ionization from particles as a cause for contour changes was ruled out. The observed phenomena can be described as the interaction of two effects: the normal decrease of density at equal heights at northern latitudes, and the expansion effects around h_{max} produced by long term solar illumination. (UK)

34324 MULTI-EXPERIMENT DETECTION OF THE PLASMAPAUSE FROM EOGO SATELLITES AND ANTARCTIC GROUND STATIONS. Carpenter, D. L. (Stanford Univ., Calif.); Park, C. G.; Taylor, H. A. Jr.; Brinton, H. C. J. Geophys. Res., 74: 1837-47(Apr. 1, 1969).

Three independent methods of detecting the plasmapause are compared: (1) the GSFC ion mass spectrometers on OGO 1 and OGO 3; (2) Stanford University/Stanford Research Institute broadband vlf receivers (0.3 to 12.5 kHz) on OGO 1 and OGO 3; (3) Stanford University broadband vlf receivers at ground stations Eights and Byrd, Antarctica, near the 90°W meridian. In the satellite vlf data the plasmapause crossings are identified by abrupt changes in observed whistler and vlf noise activity and by noise bands of limited duration. In two cases of simultaneous vlf and ion data from the same EOGO satellite, plasmapause crossings were detected by both experiments within less than 0.1 R_E in L value. In eight cases of OGO 1 ion data and simultaneous ground whistler data spaced from 1 to 12 hours from OGO 1 in local time, good agreement was found between the measured plasmapause positions. The comparisons provide new verification of the essentially worldwide extent of the plasmapause and also verify previous indications that the radius of the plasmapause is frequently about constant over large local-time sectors in the range 0 to 18 LT. (auth)

34325 NORTH–SOUTH CROSS SECTIONS OF THE EQUATORIAL ELECTROJET IN THE PACIFIC AND THE EFFECT OF A SOLAR ECLIPSE. Gassmann, G. J.; Wagner, R. A. (Air Force Cambridge Research Labs., Bedford, Mass.). J. Atmos. Terrest. Phys., 31: 781-92(June 1969).

The aim was to observe experimentally dynamic features of the electrojet during individual days and hours in order to aid theoretical studies on electrical fields in the ionosphere. During June 1965 six magnetic and ionospheric horizontal cross sections near local noon across the dip equator in the Central Pacific were obtained by airborne equipment. The removal of the magnetic effects of the ocean bottom from the magnetic data was sufficiently successful to observe variations in width and shape of the electrojet. The observed north–south cross sections showed irregular shape and striations. The latter stayed fixed for two hours or longer on a magnetically quiet day; on a moderately disturbed day drastic changes in width and form occurred. Ionospheric Esq and Ess echoes appeared consistently in the center of each cross section. During the May 30, 1965 eclipse the path of totality crossed the electrojet. A gradual decrease of field intensity of up to 50 γ was observed prior to totality and a quick return to normal thereafter. The path of totality appeared to have caused the electrojet to deviate temporarily from its normal position. (auth) (UK)

34326 THEORETICAL TREATMENT OF THE DYNAMICAL BEHAVIOUR OF THE F-REGION DURING GEOMAGNETIC BAY DISTURBANCES. Ruester, R. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). J. Atmos. Terrest. Phys., 31: 765-80(June 1969).

The system of partial differential equations describing the dynamical behavior of the F region under the influence of a time-dependent electric and a constant magnetic field is solved by a numerical method of approximation. It is shown that movements of ionized particles produce neutral air winds which again react upon the movement of ionization. The extent to which the numerical results depend on various ionospheric parameters is discussed. For two geomagnetic bay disturbances occurring during nighttime the respective real height variations of the F2 layer were deduced from ionograms. For one of these disturbances, the theoretically derived results were compared with the observed results. The comparison shows that the movement of the F layer caused by electromagnetic forces may be described sufficiently well by the present theory. The electric fields of the order of 5 V/km and the conductivities necessary to explain the observations are confirmed by other investigators. Possible sources of error and their influence on the results are discussed. (auth) (UK)

34327 AN INCREASE IN THE HORIZONTAL MAGNETIC VARIATION NEAR 8° DIP LATITUDE. Stening, R. J. (Univ. of Queensland, Brisbane). J. Atmos. Terrest. Phys., 31: 849-52 (June 1969).

Published curves of the variation of ΔH with latitude show a peak near 8° dip latitude. It is also found that the F region provides a greater relative contribution to the integrated transverse conductance of tubes of magnetic force which intersect the dynamo levels near 8° dip latitude. (auth) (UK)

34328 A SURVEY OF THE SUDDEN ENHANCEMENTS OF ATMOSPHERICS (SEA) DATA RECORDED AT THE ROYAL OBSERVATORY IN EDINBURGH DURING THE INTERNATIONAL GEOPHYSICAL YEAR. Reid, John H. (Lockheed Electronics Co., Houston, Tex.). J. Atmos. Terrest. Phys., 31: 859-63(June 1969).

An average time lag of 5.9 minutes was found between the maximum of the flare and the maximum of the resulting SEA. This is smaller than the previous values, but may be due to the use of a definitive flare list instead of light-curves. Events during the IGY included in earlier work show a two minute difference between flare maxima. There are no marked asymmetries of the flares producing SEA's either east–west or north–south. Between sunrise and sunset only 4% of class 1 and 1+ flares, 27% of class 2 and 2+ and 57% of class 3 and 3+ produced SEA's. Thus the percentage association, based on 3705 flares, is smaller than previous work had suggested. This seems to be due to the better coverage of the optical events during the IGY period. (auth) (UK)

34329 THOMSON SCATTER OBSERVATIONS OF A GRAVITY WAVE IN THE IONOSPHERIC F REGION. Vasseur, G.; Waldteufel, P. (Centre National d'Etudes des Telecommunications, Paris). J. Atmos. Terrest. Phys., 31: 885-8(June 1969).

Thomson scatter observations of the ionospheric F region revealed important oscillations of the ionization density, velocity, and temperatures. These oscillations are interpreted using the

theory of internal gravity waves originating in the auroral zone, and their presence appears to be correlated with strong magnetic activity. (auth) (UK)

34330 COLLISION FREQUENCY OF ELECTRONS IN THE F REGION. Setty, C. S. G. K.; Jain, A. R.; Vyawahare, M. K. (Univ. of Delhi). J. Atmos. Terrest. Phys., 31: 883-4(June 1969).

The electronic collision frequency at the peak of the F layer was measured at Delhi near the time of ground sunrise using the fixed-frequency method first employed by Farmer and Ratcliffe (1935). The mean of 42 measurements made during the period October–November 1967 was found to be $(3.9 \pm 0.2) \times 10^5$ sec^{-1} referring to a mean true height of (290 ± 20) km. (auth) (UK)

34331 THE USE OF f_0F2 DATA TO REMOVE THE AMBIGUITY IN TOTAL ELECTRON CONTENT DATA. Yuen, P. C.; Roelofs, T. H.; Young, D. M. L. (Univ. of Hawaii, Honolulu). J. Atmos. Terrest. Phys., 31: 877-81(June 1969).

The use of f_0F2 data to remove the ambiguity present in total electron content data obtained by measuring the Faraday rotation of signals from geostationary satellites is discussed. Plots are presented relating content and f_0F2 at Hawaii on a monthly basis. Analysis of the data shows that content does not vary as $(f_0F2)^2$ as predicted by a Chapman layer with constant scale height, but varies as $(f_0F2)^{2(1-p)}$ with the exponent exhibiting both seasonal and long-term changes. (auth) (UK)

34332 LOW-LATITUDE SPORADIC E ASSOCIATED WITH GEOMAGNETIC ACTIVITY. Closs, R. L. (Univ. of Hong Kong). J. Atmos. Terrest. Phys., 31: 873-5(June 1969).

Intense sporadic E at Hong Kong (dip angle 22°) was found to be associated with large values of the magnetic index K_p. (auth) (UK)

34333 LATITUDE VARIATION OF THE DELAYS BETWEEN SPREAD-F AND MAGNETIC ACTIVITY. Raju, P. T. Sanyasi; Rao, B. Ramachandra (Andhra Univ., Waltair, India). J. Atmos. Terrest. Phys., 31: 869-72(June 1969).

The delays between spread-F and magnetic activity vary with latitude in a way that is shown to be different at different parts of the solar cycle. The positive correlation between spread-F and magnetic activity observed at high latitudes during sunspot maximum changed to negative during sunspot minimum. (auth) (UK)

34334 ON THE CONTROL OF THE F-REGION DRIFT VELOCITY BY THE E-REGION ELECTRIC FIELD: EXPERIMENTAL EVIDENCE. Balsley, Ben B.; Woodman, R. F. (Jicamarca Radar Observatory, Lima). J. Atmos. Terrest. Phys., 31: 865-7(June 1969).

Experimental evidence is presented which shows a good correlation between velocity variations of (1) the vertical motions of the F-region electrons in the equatorial ionosphere, and (2) the horizontal motions of electrons in the underlying E region. This observation supports the theory that the E-region electric fields are projected into the F region along the electrically equipotential magnetic field lines. (auth) (UK)

34335 ON GREEN LINE SUPPRESSION IN TYPE-B AURORAE. Brown, R. R. (Univ. of California, Berkeley). J. Atmos. Terrest. Phys., 31: 855-8(June 1969).

A new mechanism is proposed for green (λ5577) line suppression in type-B aurorae, based on experimental evidence that recombination of O_2^+ with ionospheric electrons is the dominant source of the ^1S state of the O I in aurorae. The mechanism depends on the rapid increase of the negative ion–electron ratio below the O_2–O transition region at night, which is predicted by the current negative ion chemistry model of the D region. (auth) (UK)

34336 ELECTRON VELOCITY DISTRIBUTION AND THE INTERPRETATION OF CROSS-MODULATION EXPERIMENTS. Purkait, N. N.; Nag, B. R. (Univ. of Calcutta). J. Atmos. Terrest. Phys., 31: 853-4(June 1969).

The change in ionospheric conductivity produced by a disturbing field depends on the energy loss factor G. The three possibilities that G is independent of electron energy, E, or varies as E^{-1} or $E^{-\frac{1}{2}}$, are discussed. (auth) (UK)

34337 COMPARISON OF A3-ABSORPTION MEASUREMENTS AT LF AND ROCKET-MEASURED D-REGION PROFILES. Cumme, G. A.; Lauter, E. A. (Heinrich-Hertz-Inst. for Solar-Terrestrial Physics, Kuehlungsborn, Ger.). J. Atmos. Terrest. Phys., 31: 845-8(June 1969).

Comparison is made of ground-based absorption results at low frequencies and available rocket measurements of D-region electron density profiles at comparable solar zenith angles in the same season. Full-wave treatment is used. In spite of considerable longitude and latitude differences between these measurements, there is reasonable agreement between computed and observed absorption, if the rocket measured electron density and collision frequency profiles are used. (auth) (UK)

34338 RESULTS OF ROCKET MEASUREMENTS IN THE LOWER AURORAL IONOSPHERE. Folkestad, K. (Norwegian Defense Research Establishment, Kjeller); Landmark, B.; Slovli, G.; Kane, J. A. J. Atmos. Terrest. Phys., 31: 835-44(June 1969).

Rocket measurements of electrons, positive ions, and particles with energies greater than 40 keV in the ionospheric D region are reported. From the particle data the height variation of the production of ion pairs is derived. This in turn is combined with the electron and ion measurements in an attempt to estimate the numerical values of the ion–ion recombination coefficient α_i. The results indicate a variation of α_i from 10^{-6} to 10^{-7} cm sec^{-1} in the height range from 70 to 80 km. (auth) (UK)

34339 NIGHT-TIME DECREASES IN F2-LAYER HEIGHTS AT NEAR-CONJUGATE STATIONS IN LOW LATITUDES. Bullen, J. M. (Dept. of Scientific and Industrial Research, Christchurch, New Zealand). J. Atmos. Terrest. Phys., 31: 827-34(June 1969).

An analysis was made of decreases in F-region heights occurring in the night hours at Rarotonga and Maui during the first half of 1958. The probability of height decreases being observed simultaneously at these near conjugate stations was related to Honolulu K-index and to the east–west dimension of the zone of height decrease. A particular case was examined and the behavior pattern analyzed by means of electron density profiles. Height contours of ion density suggest that differences in behavior at the two stations are partly due to seasonal differences in the height of the F region. (auth) (UK)

34340 5577-A NIGHTGLOW AND ATMOSPHERIC MOVEMENTS. Gadsden, M.; Marovich, E. (Environmental Science Services Administration, Boulder, Colo.). J. Atmos. Terrest. Phys., 31: 817-25(June 1969).

The radiance of the forbidden oxygen emission line at 5577 Å from the night sky depends mainly upon the density of atomic oxygen near 100-km altitude. The profile of atomic oxygen density with altitude varies with, among other things, the strength of any vertical winds at these altitudes. Tohmatsu and Nagata (1963) examined this problem and concluded that vertical wind speeds of the order of 1 cm sec^{-1} would have an enormous effect on the radiance of 5577-Å emission. The problem is re-examined taking an empirical atomic oxygen profile derived from rocket-borne airglow measurements, and the effect of adiabatic compression and rarefaction is considered, to see if pressure waves in the region are likely to cause significant variations in radiance. The authors derive, in the course of the analysis, possible atmospheric quenching coefficients for the upper levels involved in the Herzberg and 5577-Å emissions. In addition, the analysis suggests that the eddy diffusion coefficient near 100 km could be less than that favored by Colegrove, Hanson, and Johnson (1965). (auth) (UK)

34341 ON THE AXIAL ASYMMETRY OF THE GEOMAGNETIC DISTURBANCE FIELD IN THE LOW LATITUDES. Raja Rao, K. S. (India Meteorological Office, Trivandrum). J. Atmos. Terrest. Phys., 31: 803-16(June 1969).

A study was made of the low latitude asymmetry in the disturbance field by computing equivalent current vectors for the asymmetric disturbance field during 5 magnetic storms, after allowing for the Sq variation and for declination changes. Large low-latitude asymmetry in the D field is accompanied by magnetic activity in high latitudes. Strong equatorward currents are located on the afternoon–evening side. Comparison of the storm magnetograms of Kakioka and San Juan indicates that the asymmetry in the low-latitude disturbance field is associated with increase in the Kp index. It is suggested that there is an injection of a plasma which is responsible for the partial inflation of the magnetosphere and that the resultant asymmetric D-field is related, in some way, to the generation of the Dp currents. (auth) (UK)

34342 AIRGLOW AND STAR PHOTOGRAPHS IN THE DAYTIME FROM A ROCKET. Evans, D. C.; Dunkelman, L. (Goddard Space Flight Center, Greenbelt, Md.). Science, 164: 1391-3(June 20, 1969).

Photographs of the constellation Cygnus taken in the daytime from altitudes above 100 km indicate that the day sky brightness in the wavelength region from 3600 to 7000 Å is only slightly brighter than the night sky viewed from the ground. No diffuse cloud of particles was apparent in the vicinity of the rocket payload, but discrete particles must be considered in the design of instruments for rockets and satellites. The resultant data and reports of star sightings from manned spacecraft indicate similar optical environments for both types of vehicles, that is, discrete particles and relatively low levels of background brightness, only slightly brighter than the night sky as an upper limit. (auth)

34343 THE DEPENDENCE OF IONOSPHERIC ABSORPTION OF RADIO WAVES ON EQUIVALENT FREQUENCY, WITH SPECIAL EMPHASIS ON THE WINTER ANOMALY. Nitzsche,

P. (Heinrich-Hertz Institut, Berlin). Z. Geophys., 35: 303-10 (1969).

The height variation of the absorption index A (db MHz^2) for sunspot minimum conditions was derived from absorption data obtained by the methods of field strength recordings (A3), vertical pulse sounding (A1), and cosmic-noise measurements (A2) at medium latitudes. For this purpose, the absorption index is presented as a function of equivalent frequency, f_e, showing fairly regular trends, markedly different for summer and winter conditions. The index of excessive winter absorption, ΔA (db MHz^2), increases steeply with frequency between f_e = 750 kHz and f_e = 1500 kHz, and becomes nearly constant for f_e > 2500 kHz. This supports the suggestion that the phenomenon of winter anomaly is situated relatively high in the mesopause and lower thermosphere region (85 to 100 km). (auth)

34344 EXISTENCE OF SOMETIMES CONSIDERABLE TRANSPORT EFFECTS IN THE NIGHTTIME IONOSPHERE. Schoedel, J. P. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). Z. Geophys., 35: 297-301(1969).

Faraday rotation measurements were carried out with the geostationary satellite ATS-3. Two examples of nighttime transport effects in the ionosphere are shown and an estimate is made of the direction of transport and the order of magnitude of transported ionization. (auth)

34345 THE EFFECT OF THE EARTH'S CONDUCTIVITY ON IONOSPHERIC SHIELDING. Ashour, A. A. (Cairo Univ.). Z. Geophys., 35: 269-76(1969).

Calculations were made of the magnetic field of the currents induced in a nonuniformly conducting ionospheric shell and a concentric perfectly conducting core by an external periodic magnetic field. The model considered is the same as that has been treated earlier by Ashour and Price except that now the conductivity of the Earth is taken into account. The results show that the introduction of the core has a considerable effect on the observed field. The shielding of the ionosphere to changes in the Earth's field originating from external sources and the difference between the screening of the day and night hemispheres are reduced due to the coupling between the Earth and the ionosphere. (auth)

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Refer also to abstract 34515.

34346 (BNL-13716) SIMPLE MODEL OF THE SMITH SUPERCONDUCTING CABLE. Morgan, G. H. (Brookhaven National Lab., Upton, N. Y.). May 5, 1969. 14p. Dep. CFSTI.

The Smith superconducting cable consists of a single strand of a normal metal in which is embedded a large number of paraxial superconducting filaments or cores, the strand being twisted with a certain pitch (p). Smith came to the conclusion that if such a conductor is exposed to an external changing field, B_a, the currents induced for $p/2 < l_c$ (a certain critical length) are largely confined to the filaments, and the power losses are thus mainly the usual hysteretic loss in the filaments. Smith's expression for l_c is $l_c^2 \approx \lambda J_c d\rho/\dot{B}_a$, where J_c is the critical current density in the superconductor, d is the filament diameter, ρ the normal metal resistivity, $\dot{B}_a$ is the rate of change of field, and λ is a constant approximate unity. These results are confirmed here, but it is found that the equation may have a different form depending on the core configuration. Expressions for the power loss in the normal metal and the time constant are obtained for the case $l < l_c$. (TSS)

34347 TIME-DEPENDENT GINZBURG-LANDAU EQUATIONS FOR STRONG-COUPLING SUPERCONDUCTORS. Fulde, Peter (Univ., Frankfurt am Main); Maki, Kazumi. Phys. Kondens. Mater., 8: 371-83(1969).

Time-dependent Ginzburg-Landau equations are derived for strong-coupling superconductors. It is shown that, because of a certain separability of the order parameter, the equation for it's time-dependent fluctuations is of diffusion-type. Strong-coupling effects show up only in the numerical coefficients of the diffusion equation. The findings are applied to the problem of electrical resistivity in strong-coupling superconducting materials above the transition temperature T_c. (auth)

34348 ON THE INFLUENCE OF EXCITON-EXCITON INTERACTION ON THE CRITICAL TEMPERATURE OF BOSE-EINSTEIN CONDENSATION. Majernikova, E. (Inst. of Physics, Bratislava). Czech. J. Phys., 19: 821-6(1969).

Under the assumption of a sufficiently large concentration of a weakly repulsive interacting exciton system, the realization of the "superfluid" state of this system is theoretically possible. The influence of the interaction on the critical temperature of the Bose-Einstein condensation with application to the case of the lowest exciton states in a benzene crystal is dealt with, using previous results (Czech. J. Phys., B18: 830(1968)). It was found that this interaction causes a rapid decrease of the critical temperature. (auth)

34349 MODULATION OF A THERMOMAGNETIC EFFECT AT LOW TEMPERATURES AND DETECTION BY SECOND SOUND IN HELIUM. Vidal, F.; Simon, Y.; Le Ray, M.; Thorel, P. (Ecole Normale Superieure, Paris). Rev. Phys. Appl., 4: 50-6(Mar. 1969). (In French).

In calorimetry and in the study of different types of thermal effects, at very low temperatures, several authors have preferred to use a heat-current-modulation technique along with synchronous detection of the thermal amplitudes rather than a steady heat-current technique. Instead of being isolated, the sample and the bath are coupled through a weak heat leak and the modulating frequency ranges from 5 to 10 c/s. Another method of modulation is proposed which enables work at higher frequencies in the audio range, provided the heat current amplitude is sufficient, for instance, in this case, greater than 10^{-5} W/cm^2. The sample is in direct contact with a bath of superfluid helium; the heat current is partly diverted into the helium and creates a second sound wave. This wave is amplified by a resonant pipe (Q = 125 at 300 C/s) shut at one end by the sample and at the other end by a receiver. This method has been applied to the study of the Ettingshausen effect in a type-II superconductor. (auth)

34350 THIRD SOUND AND THE ONSET OF SUPERFLUIDITY IN UNSATURATED HELIUM FILMS. Goodstein, David (California Inst. of Tech., Pasadena). Phys. Rev., 183: 327-34(July 5, 1969).

A simple model, commonly used for describing the behavior of the superfluid film is examined, and it is found to become spontaneously unstable when the partial molar entropy falls below a certain finite value for each temperature and film thickness. The instability is proposed as the cause of the onset curve for superfluidity in unsaturated films, and comparisons with experiment are made. In addition, the use of thermodynamic identities in the model leads to a new and more accurate expression for the velocity of third sound in terms of other measurable quantities. (auth)

34351 PRESSURE-DRIVEN SUPERFLUID HELIUM FLOW. Notarys, H. A. (Ford Scientific Lab., Newport Beach, Calif.). Phys. Rev. Lett., 22: 1240-2(June 9, 1969).

From the Langer and Fisher thermal-fluctuation theory the pressure-velocity dependence for pressure-driven intrinsic superfluid helium flow was found to be $p \propto \exp(-\beta\rho_s/\rho v_s kT)$. Experiments of pressure-driven intrinsic flow through submicron pores in porous mica are in agreement with this relation. (auth)

34352 BOSE-EINSTEIN CONDENSATION FOR A CLASS OF WAVE FUNCTIONS. Reatto, L. (Univ., Milan). Phys. Rev., 183: 334-8(July 5, 1969).

It is verified that the class of wave functions used in variational calculations for ^{4}He has Bose-Einstein condensation. These trial wave functions have the form of a product of pair functions. Two cases are considered: in the first, the correlations in the wave functions are assumed to be short range; and, in the second, the correlations include also the long-range part due to the zero-point motion of phonons. The one- and two-dimensional system is briefly considered. (auth)

34353 TEMPERATURE DEPENDENCE OF THE SURFACE-SHEATH NUCLEATION FIELD IN STRONG-COUPLING SUPERCONDUCTORS. Kirschenbaum, Jay; Kao, Yi-han (State Univ. of New York, Stony Brook). Phys. Rev. Lett., 22: 1177-80 (June 2, 1969).

The surface-sheath nucleation field H_{c3} in Pb-0.25% Bi alloy, a clean strong-coupling type-I superconductor, was measured from 1.7°K to near T_c(7.2°K). The data allowed a direct determination of the slope $(dH_{c3}/dT)T_c$ which, along with the temperature dependence of H_{c3} near T_c, is compared with results predicted by recent theories. (auth)

35354 SUPERCONDUCTIVITY OF Nb_3Al. Willens, R. H. (Bell Telephone Labs., Murray Hill, N. J.); Geballe, T. H.; Gossard, A. C.; Maita, J. P.; Menth, A.; Hull, G. W. Jr.; Soden, R. R. Contract AFOSR 1510-68. Solid State Commun., 7: 837-41(June 1969).

Nb_3Al was found to undergo a transition to the superconducting state starting at 18.8°K. This is the highest known transition temperature for any single-phase binary alloy with the β-tungsten structure. Some of its electronic properties, including specific heat, magnetic susceptibility and Knight Shift, were studied. It is concluded that the one-dimensional model postulated by Labbé and

Friedel to explain the properties of other high-temperature superconductors is inconsistent with these measurements. (auth) (UK)

34355 MAGNETIC SUPERHEATING OF HIGH-κ SUPERCONDUCTORS. Christiansen, P. Voetmann (Univ. of Copenhagen). Solid State Commun., 7: 727-9(May 15, 1969).

The one-dimensional Meissner state in a superconducting half-space becomes unstable against three-dimensional fluctuations when the external magnetic field exceeds $H_u(\kappa)$. An analytic expression for the critical fluctuation and the field $H_u(\kappa)$, valid for $\kappa \gg 1$ is derived. (auth) (UK)

34356 CRITICAL REGION FOR THE ISING MODEL WITH A LONG-RANGE INTERACTION. Thouless, D. J. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 181: 954-68(May 10, 1969).

A version of the Ising model is developed in which the spin variables can be treated accurately in the continuum approximation. The perturbation series, both above and below the critical temperature T_c, is examined, and it is shown that there is a shift of T_c from its mean-field value proportional to q^{-2} lnq, as well as the well-known shift proportional to q^{-1}; here q is the number of mutually interacting particles. It is shown, using renormalization theory, that there is a perturbation series in $q^{-1}|T - T_c|^{-\frac{1}{2}}$ for which all terms are finite in the limit $q \to \infty$, if the shift of T_c is put in correctly. For the two-dimensional model, the shift is shown to be proportional to q^{-1} lnq. Conditions are derived for a finite system to display critical behavior characteristic of three, two, one, or zero dimensions. It is shown how similar results can be obtained for a model similar to the Heisenberg model and for the standard Ising and Heisenberg models with interactions extending over many neighbors. A comparison is made between previously calculated numerical results for T_c and the asymptotic forms derived here. (auth)

34357 SUPERCONDUCTION WITHOUT SUPERCOLD? Firth, Ian (St. Andrews Univ., Scotland). New Sci., 42: 644-7(June 19, 1969).

Superconductivity obstinately remains a phenomenon of very low temperatures, although it has now been produced in special alloys above the boiling point of hydrogen. Chances of a liquid-nitrogen-temperature superconductor, or of zero resistance at room temperature are discussed. (auth) (UK)

34358 A PEAK EFFECT IN CRITICAL CURRENT WITH RESPECT TO TEMPERATURE AND FIELD IN A TYPE-II SUPERCONDUCTOR. Kroeger, D. M. (Oak Ridge National Lab., Tenn.). Solid State Commun., 7: 843-7(June 1969).

Maxima in curves of critical current vs. temperature at fixed fields were found to be associated with the peak effect in a 5Nb at. % Ti strip. The data were in qualitative accord with recent suggestions that a superconductor with $\partial J_c/\partial T > 0$ should show unusual stability. The ratio of the field at the peak to the upper critical field was found to be independent of temperature, having a value of 0.84. There was an indication that the dependence of thermal conductivity on temperature is anomalous in the region of the maxima. (auth)

34359 INSTABILITY OF TWO-ELECTRON BUBBLES AND BUBBLE FORMATION IN LIQUID HELIUM. Dexter, D. L. (Univ. of Rochester, N. Y.); Fowler, W. Beall. Phys. Rev., 183: 307-9(July 5, 1969).

The energy of a two-electron bubble in liquid He is computed with a correlated electronic wave function. Without correlation the bubble is unstable against decay into two one-electron bubbles; correlation reduces the energy by about ½ eV, but the bubble is still unstable. However, a free electron can be trapped by a one-electron bubble. The resulting metastable bubble will expand and presumably split into two bubbles. Experiments are suggested to test the trapping and splitting hypotheses. (auth)

34360 THERMAL CONDUCTIVITY IN ORIENTED SINGLE CRYSTALS OF HCP ^{4}He. Hogan, Edward Merrick. Durham, N. C., Duke Univ., 1968. 175p.

Thesis.

Thermal conductivity measurements have been made on carefully grown single crystals of hcp helium-4 between 1.6°K and 0.36°K. Data on crystals grown at 53.4, 85, and 125.8 atmospheres exhibit a strong orientation dependence in the Umklapp region and Poiseuille flow at temperatures below the thermal conductivity maximum. In the Umklapp region the data are described by two thermal conductivities $K_\perp = A_\perp(\theta_D/2.58\ T)$ and $K_{||} = A_{||}(\theta_D)$ exp $(\theta_D / 4.62\ T)$, the components of the thermal conductivity tensor perpendicular and parallel to the c-axis respectively. At 85 atm, $A_\perp = 1.84 \times 10^{-4}$ watts/cm°K and $A_{||} = 1.09 \times 10^{-3}$ watts/cm°K. The Umklapp data permit one to determine the orientation of the single crystals. The thermal conductivity in the Poiseuille region varies as T^6. The Normal process relaxation time determined from this data, $\tau_N(T) = (2.1 \pm 0.4)\ (\theta_D/T)^3 \times 10^{-12}$ sec, is in good agreement with the results of second sound experiments. Data on crystals grown at 85 and 125.8 atm suggest that the Umklapp process mean free path scales as log $\lambda_U \alpha \theta_D/T$ and that the Normal process relaxation time scales $\tau_N \alpha (\theta_D/T)^3$. (auth)

34361 ON THE SUPERCONDUCTIVITY, CARRIER CONCENTRATION, AND THE IONIC MODEL OF Sn_4P_3 AND Sn_4As_3. Van Maaren, M. H. (Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). Phys. Lett., 29A: 293-4(June 2, 1969).

Superconductivity is reported for $Sn_4P_{2.65}$ at $T_c \approx 1.2$°K. Hall constant and reflectivity measurements indicate a mixed type of conduction for $Sn_4P_{2.65}$ and $Sn_{3.89}As_3$. The ionic model of Geller and Hull is not applicable. (auth)

34362 DISLOCATION BEHAVIOR IN NORMAL AND SUPERCONDUCTING LEAD. Hikata, A.; Elbaum, C. (Brown Univ., Providence). Trans. Jap. Inst. Metals, 9: Suppl., 46-51(1968).

From International Conference on the Strength of Metals and Alloys, Tokyo, Japan. See CONF-670909.

The amplitude dependence of ultrasonic attenuation in normal and superconducting lead was investigated for the purpose of studying the interaction of dislocations with conduction electrons. The experiments were performed using longitudinal waves of 10, 20, and 30 Mc, propagated along the ⟨100⟩ direction of lead single crystals. Measurements were made under the following conditions: at 4.2°K with no magnetic field (superconducting state), at 4.2°K with a magnetic field larger than the critical field (normal state), and at 11°K (normal state). A maximum was found in the attenuation as a function of wave amplitude in both states of lead. The maximum occurs at higher amplitudes in the normal state. The shift in amplitude at maximum attenuation was used to determine the parameter B associated with the damping of dislocations by conduction electrons in the normal state. The analysis does not involve any ad hoc assumptions concerning inaccurately known features of the dislocation network in crystals and the result is believed to be the first of its kind. The value obtained for the damping parameter is 8.6×10^{-5} dyn sec cm^{-2}. This parameter is found to be temperature-independent, at least in the interval $4.2°K < T \lesssim 15°K$. The binding force f_m between point defects and dislocations is evaluated from the stress amplitude at maximum attenuation and the value $f_m \simeq 5 \times 10^{-7}$ dynes is obtained. From this value the observed dislocation pinning is attributed to vacancies. (auth)

Plasma and Thermonuclear Physics

Refer also to abstracts 34451 and 34452.

34363 (CONF-680113-(Vol.3)) 2nd INTERNATIONAL CONFERENCE ON THE INTERACTIONS BETWEEN OSCILLATING FIELDS AND PLASMAS, SACLAY, FRANCE, JANUARY 15-19, 1968. VOLUME III. CONFINEMENT AND STABILIZATION BY HF FIELDS ALONE OR ASSOCIATED WITH STATIC MAGNETIC FIELDS. (Institut National des Sciences et Techniques Nucleaires, Saclay (France)). 251p. (In French and English). Dep.

Separate abstracts were prepared for 5 of the 6 included papers. For an abstract of the remaining paper see CONF-680113 (Vol. 3) in the report number index. (M.O.W.)

For abstracts of individual papers see: 34368-34371 and 34474.

34364 (CONF-680113-(Vol.4), pp 1047-75) SURVEY OF RESEARCH AT LABORATOIRE DE RECHERCHES EN PHYSIQUE DES PLASMAS. Weibel, E. S. (Laboratoire de Recherches sur la Physique des Plasmas, Lausanne (Switzerland)).

The confinement of plasma by alternating magnetic fields is discussed. The technique uses a rotating magnetic pinch. Diagnostic techniques being used are briefly discussed. Some measurements are given. (M.O.W.)

34365 (ORNL-4401) THERMONUCLEAR DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1968. (Oak Ridge National Lab., Tenn.). June 1969. Contract W-7405-eng-26. 222p. Dep. CFSTI.

Separate abstracts were prepared for the 12 individual sections. (M.O.W.)

For abstracts of individual sections see: 34266, 34376-34378, 34400, 34411, 34429, 34455, 34456, and 34464-34466.

34366 PLASMA PHYSICS INDEX. Bibliography, Author Index, Subject Index. Volume 4, No. 2, 1969. Frankfurt am Main, Zentralstelle fuer Atomkernenergie-Dokumentation, 1969. 186p.

351 articles on various aspects of plasma physics are listed. (M.O.W.)

34367 PLASMA PHYSICS INDEX. Bibliography, Author Index, Subject Index. Volume 4, Number 1, 1969. Frankfurt

am Main, Zentralstelle fuer Atomkernenergie-Dokumentation, 1968. 261p.

453 articles on various aspects of plasma physics are listed. (M.O.W.)

Confinement and Heating

34368 (CONF-680113–(Vol.3), pp 919-48) THERMONUCLEAR PROSPECTS OF VARIOUS RF CONFINEMENT SCHEMES. Watson, C. J. H.

It has recently been shown that although it is impossible to design a thermonuclear reactor of reasonable size in which the plasma is confined by rf radiation pressure within a resonant cavity, the margin by which this method fails is smaller than was once supposed. This paper examines the possibility that the use of relatively low-frequency fields, or high-frequency fields supplemented by static magnetic fields, might in consequence lead to a practicable design. It is shown that low-frequency schemes only have a future if a toroidal static magnetic field is used to provide the main confining force, and that in addition, stringent precautions are taken to minimize ohmic and radiation energy losses. The use of certain slow-wave structures is proposed for this purpose. High-frequency confinement schemes are shown to require a static magnetic field shaped so that magnetic field lines only intersect a small fraction of the surface area of the plasma. In high-β devices such as the thetatron it may then be possible to design a reactor in which the rf fields simply exert radiation pressure over this fraction of the surface: in low-β devices however, this approach fails, and it is necessary to exploit the ion cyclotron resonance in order to improve the energy balance. Two alternative procedures are discussed — the "exactly resonant" approach in which rf energy is continuously dissipated at some resonant surface within the plasma, and a "nearly resonant" approach in which ions are reflected back into the plasma before they reach the resonant plane. It is shown on energetic grounds that the "exactly resonant" approach has no future: the "nearly resonant" approach, however, is found to be sufficiently promising to merit further investigation. (auth)

34369 (CONF-680113–(Vol.3), pp 949-86) POTENTIAL-WELL THEORY OF CONFINEMENT OF PLASMAS IN NON-UNIFORM RADIOFREQUENCY FIELDS. Hatch, Albert J.; Hasan, M.; Smith, W. E. (Argonne National Lab., Ill.).

The potential of a small plasma sphere in an electromagnetic field is determined as a function of plasma density. For the limiting cases of low- and high-density plasmas, the respective Φ and T potentials are computed as point functions of the field space. The resulting topological characteristics are then examined for potential wells. Examples are given for spherical and cylindrical resonant cavities. Fusion power possibilities contingent upon the use of superconducting cavities are explored. (auth)

34370 (CONF-680113–(Vol.3), pp 987-1024) FREQUENCY-SHIFTING METHOD OF EXCITING PLASMAS IN FUNDAMENTAL-MODE RESONANT CAVITIES. Hatch, Albert J.; Halverson, S. L.; Froehlich, A. E. (Argonne National Lab., Ill.).

A new frequency-shifting method of exciting a plasma in a resonant cavity is described. Shifting the exciting frequency by ~10% above the resonant frequency of the empty cavity has resulted in plasma densities about 10 times greater than were obtainable without frequency shifting. Requirements for dynamic stability of a plasma in a resonant cavity are established. The results are essential to the possible eventual rf confinement of plasmas in resonant cavity fields. (auth)

34371 (CONF-680113–(Vol.3), pp 1037-46) RF PLASMA WORK AT CULHAM LABORATORY: EXPERIMENTAL. Wort, D. J. H. (United Kingdom Atomic Energy Authority, Abingdon (England). Culham Lab.).

The HELIOS device at Culham Laboratory is designed to investigate nonresonant electron heating. Plasma generated by the resonant absorption of 3-cm microwaves forms a well-defined column, around which a slow-wave structure will be placed so as to launch slow waves at 2450 MHz into the plasma. These slow waves will give nonresonant heating. Work so far has been directed towards the determination of the plasma parameters and development of suitable diagnostic techniques, and to solving various technical difficulties with the slow-wave structure. (auth)

34372 (CONF-680113–(Vol.4), pp 1095-1103) SECONDARY CURRENT LAYERS IN ROTATING-FIELD CONFINEMENT. van der Laan, P. C. T. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica).

In general, a magnetically confined plasma column is surrounded by a low-density plasma. If one changes the direction of the magnetic field near the wall, currents in the low-density plasma oppose the penetration of the new field component to the central column. Minimum values of electron temperature and density are given here which (a) an effectively screening secondary current layer is expected, and (b) the motion of this layer is so as to conserve flux and the pitch of the helical field lines. From experimental evidence it is concluded that these conditions are at least partly met. The consequence of this is that some schemes of rotating-field confinement and of dynamic stabilization cannot be realized. The currents in the outside region may be of advantage in other configurations. (auth)

34373 (CONF-680113–(Vol.4), pp 1219-43) STEADY-STATE EFFECTS OF A HIGH-AMPLITUDE ELECTROMAGNETIC FIELD ON PLASMA. Etievant, C.; Fidone, I. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires); Chen, F. F. (Princeton Univ., N. J. Plasma Physics Lab.). (In French).

Continuous nonlinear effects in the excitation of very large-amplitude waves from the heating of a plasma by means of high-frequency oscillations are studied. The general equations of the problem are described, using a fluid model and separating the steady-state perturbations from the oscillating perturbations with the help of an averaging technique. A column of cylindrical plasma in a homogeneous magnetic field is considered. The steady-state velocity of each group of particles is evaluated in the case of self-interaction and in the case of a stationary wave. (J.F.P.)

34374 (MATT-Trans-80) LIFETIME OF CHARGED PARTICLES IN A TOKAMAK TM-3 PLASMA. Kuznetsov, E. I. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). Translated for Princeton Univ., N. J., from report IAE-1636. 21p. Dep. CFSTI.

For the conditions investigated in the TM-3 device, the charged-particle lifetime in the plasma turned out to be several milliseconds. Only in a few cases (small discharge currents or large pressures) does the ionization rate of the hydrogen atoms become comparable to the rate of variation of the electron concentration in the plasma column. Consequently, the influx of electrons as a result of ionization does not play a primary role in the charged-particle balance in the plasma column. The particle lifetime is given as a function of the discharge current, the longitudinal magnetic field, and the initial pressure, the τ values referring to the fourth millisecond of discharge and averaged for several discharges under each set of experimental conditions. For comparison, the same graphs also contain data for the energy retention lifetime τ_e, obtained earlier by G. A. Bobrovskii and K. A. Razumova. (M.O.W.)

34375 (NP-tr-1794) USE OF THE M AND S CONFIGURATION IN THETA PINCHES. Wolf, G. H. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Translated from pp 1-110 of report IPP 1/63. 73p. (CTO-458). Dep. CFSTI.

An abstract for the original German report appeared in NSA 21: 37489. (M.O.W.)

34376 (ORNL-4401, pp 25-44) TARGET PLASMAS. (Oak Ridge National Lab., Tenn.).

MAGNETIC MIRROR MACHINES — electron trapping during electron cyclotron heating in, (E/T)
PLASMA — properties in INTEREM mirror field with quadrupole coils, (E/T)
— heating by electron cyclotron waves in mirror fields, electron trapping in, (E/T) (M.O.W.)

34377 (ORNL-4401, pp 79-97) ELECTRON-CYCLOTRON HEATING. Becker, M. C.; Dandl, R. A.; Eason, H. O.; Edmonds, P. H.; England, A. C.; Ezell, J. C.; Livesey, R. L.; McGuffin, M. W.; Snell, A. H. (Oak Ridge National Lab., Tenn.).

MAGNETIC MIRROR MACHINES — power source for ELMO, high-power microwave, (E)
— plasma diamagnetism in, high-beta
MICROWAVE EQUIPMENT — design of high-power source for ELMO facility, (E)
— development for ELMO facility
PLASMA — diagnostics of high-β, diamagnetism in magnetic mirrors
— radiations from hot-electron, scattering and energy loss rates in, (E/T) (M.O.W.)

34378 (ORNL-4401, pp 98-112) TURBULENT HEATING. (Oak Ridge National Lab., Tenn.).

The following topics were studied in relation to Burnout V: (1) plasma radial profile, (2) spectroscopic diagnostics, (3) energy fluctuations, (4) effect of helium impurity, (5) Doppler-broadened neutral emission, (6) magnetic field strength effects and heating efficiency, (7) hf correlation studies and rf effects, and (8) plasma

losses induced by turbulent heating. The turbulent heating of electrons in mirror geometries is also discussed. (M.O.W.)

34379 TRANSPORT COEFFICIENTS OF THE PLASMA IN THE TOKAMAK TM-3 APPARATUS. Bobrovskii, G. A.; Vinogradova, N. D.; Kuznetsov, E. I.; Razumova, K. A. JETP Lett. (USSR) (Engl. Transl.), 9: 158-60(Mar. 5, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 9: 269-73(Mar. 5, 1969).

Experiments were performed in the TM-3 apparatus under macroscopically stable discharge conditions in hydrogen. The different types of energy loss were investigated separately. (M.O.W.)

34380 CONTAINMENT OF A PLASMA BY A ROTATING MAGNETIC FIELD. Penfold, Alan S.; Fonda-Bonardi, Giusto (to Litton Industries, Inc.). U. S. Patent 3,442,758. May 6, 1969. Filed Aug. 7, 1963.

The present invention involves the use of a rotating electromagnetic field to provide a closed potential well which powerfully confines an ionized gas plasma. One structure which may be employed to implement the invention utilizes coaxial coils energized to generate an electromagnetic field which rotates at high speeds about an annular zone within an enclosing container. In a microwave implementation of the invention, a closed potential well is formed by the excitation of two microwave modes in the cylindrical cavity. The efficiency of the microwave generation apparatus may be increased by the use of vanes which pick up electrons as they leave the potential well as a result of space charge field effects. (AEC)

Diagnostics

Refer also to abstracts 34308 and 34403.

34381 (AD-679530) DEVELOPMENT OF DIAGNOSTIC METHODS FOR SEEDED AIR AND NITROGEN PLASMAS. Final Report, June 15, 1967-June 15, 1968. Olsen, H. N.; Bedjai, G.; Kelly, F. L. (Plasma Sciences Labs., Inc., Van Nuys, Calif.). Dec. 1968. Contract F40600-67-C-0017. 84p. (AEDC-TR-68-217. CFSTI.

Absolute emission coefficients of nitrogen atomic lines, of a wavelength increment of the N_2^+ (1-) (0,0) band system, of the electron continuum and of several atomic lines of the seed material were measured in atmospheric pressure nitrogen and air plasma jets seeded with K_2CO_3 powder. Radial-temperature distributions determined from measured emission coefficients were compared as the mean temperature of the plasma was reduced from 6000 to 3000°K. In the lower range, which is most characteristic of the seeded-air accelerator, temperatures determined from both absolute and relative intensities of atomic lines of the seed material agree well with those obtained from the electron continuum. The best species of radiation for temperature measurements in the range of 2500 to 4000°K was, as the result of the investigation, selected to be the continuous radiation emitted by the seed material itself. Errors in temperature determined from the measured continuum and resulting from averaged variations in seed concentration and its uniformity of distribution are shown to be less than 5% in the lower temperature range. (auth) (USGRDR)

34382 (AD-681728) DETERMINATION OF ELECTRON TEMPERATURES BETWEEN 50 eV AND 100 keV FROM X-RAY CONTINUUM RADIATION IN PLASMAS. Final Report. Elton, R. C. (Naval Research Lab., Washington, D. C.). Dec. 11, 1968. 70p. (NRL-6738). CFSTI.

Previous calculations of the total integrated bremsstrahlung radiation passing through absorbing foils of beryllium, aluminum, and nickel (as well as aluminum and nickel in combination with carbon (polyethylene)) are included and extended to cover temperatures equivalent to an energy range from 50 eV to 100 keV and to include gold. Such information is necessary in obtaining values for the electron temperature in a plasma from measurements of the soft x-ray continuum emission. The spectral distribution of the transmitted continuum radiation is presented over the entire temperature range, for use in determining the most suitable spectral region. (auth) (USGRDR)

34383 (AD-681838) THE RESPONSE OF FREE MOLECULE CYLINDRICAL LANGMUIR PROBES IN A TURBULENT PLASMA. Peterson, Edward (California Univ., Berkeley. Div. of Aeronautical Sciences). Nov. 1968. Contract Nonr-222(45). 147p. (AS-68-10). CFSTI.

A theoretical and experimental investigation of the response of a free molecule Langmuir probe in a turbulent plasma is made. The effect of arbitrary fluctuations in charged-particle density, electron temperature, plasma potential, and ion temperature are considered. The results are applicable for (a) frequencies somewhat less than the ion plasma frequency, (b) moderate ratios of probe radius to Debye length, (c) moderate ratios of applied potential to electron temperature, and (d) ratios of ion to electron temperatures <1. The steady-state characteristic is obtained by forming an empirical fit to a numerical analysis describing the collisionless probe current collection. Relations are then derived showing the effect of fluctuations on the average properties, and the connection between the rms probe current and the various correlations. Electron temperature, charged-particle density, floating potential, single-probe saturation ion and electron current, and double-probe current measurements are studied in detail. It is found that the sensitivity of the probe to the various fluctuating quantities is a function of the ratios of probe radius to Debye length, applied potential to electron temperature, and ion to electron temperature. Subsequently, it is shown that many of the correlations and average properties may be determined. Experiments are performed in an unsteady highly expanded low-density flowing argon plasma. Both the average and rms currents are monitored using cylindrical Langmuir probes. (auth) (USGRDR)

34384 (AD-681904) A DESCRIPTION OF LASER-PRODUCED PLASMAS. I. ELECTRON AND ION TEMPERATURES. Allen, Frank J. (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Dec. 1968. 38p. (BRL-1426). CFSTI.

A method is derived for obtaining ion temperature in laser-produced plasmas from experimental results. Ion temperatures are then obtained from published data. Various determinations of electron temperatures in similar plasmas are considered. It is found that for incident laser beam intensities on solid targets in the range of 10^{10} or 10^{11} W/cm^2, electron and ion temperature lie between 10 and 20 eV. Means of improving experimental results, on which the ion temperature determinations are based, are also discussed. (auth) (USGRDR)

34385 (AD-682519) LANGMUIR PROBE IN A COLLISION DOMINATED PLASMA WITH A HIGH-ENERGY NUCLEAR RADIATION BACKGROUND. Battle, E. L.; Baran, M. F. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering). Dec. 1968. 88p. (AFIT-TR-68-11). CFSTI.

The use of probes in collision-dominated plasmas is becoming more necessary and hence more common. As a result, theoretical studies of collisional probe properties and rapid time response were performed. The purpose of this report is to consider the use of Langmuir probes or other techniques to measure the time-dependent behavior of the electric field and electron density in slightly ionized air at 1 atm, in the presence of a 10,000 V/m electric field (maximum value), 1 gauss magnetic field, and a mixed high-energy neutron and gamma radiation field. Attention is given to collisional effects, the effect of the radiation on the probe response and output, and the probe capacitance and response time. (auth) (USGRDR)

34386 (AD-683090) INVESTIGATION OF PLASMA PARAMETERS IN A STRONG MAGNETIC FIELD WITH THE AID OF DOUBLE ELECTRIC PROBES. Kovan, I. A.; Moskvin, Yu. L.; Rusanov, V. D.; Smirnov, V. P. Translation of a Monograph. 16p. (FTD-MT-24-29-68). CFSTI.

In view of the doubtful reliability of data obtained with probes on a plasma in a strong magnetic field, when the particle Larmor radius is comparable with the probe characteristic dimension, the authors have checked on the probe readings by other diagnostic means. The plasma parameters measured were electron temperature and charged-particle density at saturation. The electron temperature was determined by plotting the derivative of the current with respect to the voltage against the probe voltage. The charged-particle density was measured by determining the saturation current and also by measuring the derivative of the probe current with respect to the voltage in the vicinity of zero voltage. The effect of the probe size was also investigated. It is shown that the probe measurements deviate from the others by as much as 40% and become particularly unreliable in strong magnetic fields. (auth) (USGRDR)

34387 (AD-683353) BASIC STUDIES REGARDING LINE BROADENING. Final Report, June 1, 1966-May 31, 1968. Schluter, Hans (Texas Univ., Austin. Plasma Physics Lab.). Oct. 1968. Contract AF33(615)-5116. 45p. (ARL-68-196). CFSTI.

The ratio of halfwidth to critical value for the transition between quasi-static and impact domain of electron contributions to linear Stark broadening (according to Unsöld) is expected to vary n^4, where n is the upper principle quantum number of the line considered. Low-density plasmas generated by a radiofrequency arrangement permit the observation of many nonoverlapping Balmer lines and thus a drastic variation of the ratio; for identical plasma parameters, access deep into the quasi-static as well as impact regime of electron broadening is re-

alized to a degree not achieved previously. As recently suggested, the observed broadening can be approximated in terms of an effective quasi-static perturber density, which is a universal function of the displacement from the line center expressed in units of the above-mentioned critical transition value. (auth) (USGRDR)

34388 (AD-684574) PLASMA DIAGNOSTIC METHODS FOR IONIZED GAS FLOWS. Final Report. Dewey, C. F. Forbes Jr. (Colorado Univ., Boulder). Mar. 1969. Contract F33615-67-C-1850. 126p. (AFFDL-TR-68-170). CFSTI.

An investigation has been conducted to elucidate several different methods of diagnostics for ionized gas flows. Particular emphasis was placed on techniques of possible interest to the 50 Megawatt Facility at Wright Field. An analysis was completed which describes the behavior of Langmuir probes in strong magnetic fields. The detailed behavior of the results indicates that the theory is capable of describing, with reasonable quantitative accuracy, the collection properties of Langmuir probes as a function of applied potential and magnetic field strength for all magnetic fields B > 0. Thomson scattering measurements of electron density do not appear feasible for the 50 Megawatt Facility. An analysis was made of several types of atomic and molecular fluorescence radiation experiments of potential diagnostics use. It is concluded that local specie concentration measurements of NO and O2 can be accomplished using laser fluorescence excitation, and that gas velocity measurements can be made using laser excitation of the N2 Lyman-Birge-Hopfield system or the NO (beta) system and monitoring the trajectory of the excited volume of gas. Additional work completed during contract and described herein is as follows: (1) A novel method of "pumping" energy conversion devices with lasers to achieve enhanced electrical output. (2) A general survey of laser sources for line spectroscopy, (3) A new method of joining porous refractory metals. (4) Laser welding. (auth) (USGRDR)

34389 (AEC-tr-7065) SPECTROSCOPIC INVESTIGATIONS OF A HF-PLASMA SOURCE. Kelm, S.; Seeger, W.; Jawtusch, V. (Deutsche Versuchsanstalt fuer Luft- und Raumfahrt e. V., Stuttgart (West Germany)). Translated from report DLR-FB-66-61. 61p. Dep. CFSTI.

A steady-state hf discharge, produced in a torus inductively by a special coil arrangement, was investigated. Several noble gases were admitted to the plasma source in succession within a pressure range from 0.1 to 14 torr. Electron temperature, electron density, and other plasma parameters were determined by spectroscopic methods. Since under the above conditions the plasma was in the corona domain, special methods for evaluating the spectroscopic measurements were used. Values up to 40,000°K were obtained for electron temperature, and electron density was in the range of 10^{13} to 10^{15} cm^{-3}. From this, the electric conductivity was determined to be on the order of 1.6×10^4 S/m (10^{14} mho/m). (auth)

34390 (N-69-19881) METHODS OF HIGH-SPEED MEASUREMENTS IN GAS DYNAMICS AND PLASMA PHYSICS. Nesterikhin, Yu. E.; (and others). Translation of pp 1-172 of Metody Skorostnykh Izmereniy v Gazodinamike i Fizike Plasma, Moscow, 1967. 163p. (NASA-TT-F-12202). CFSTI.

Methods are described which can be used for quick-response measurement of velocity, density, temperature, pressure, concentration, magnetic and electric field intensity, etc., in shock tubes and plasma injectors, devices for rapid compression of ionized gases with magnetic fields, and other pulse-excited gas dynamics and plasma devices. Various methods of obtaining shock waves, high-speed gas streams, and high-temperature plasma are briefly analyzed. Methods for observing high-velocity gas flows are examined in detail, as are various procedures for quantitative measurements of the density of the neutral particles and electrons. Spectroscopic methods of temperature and concentration measurements and time-resolved mass spectroscopy in pulse-excited plasma generators are also discussed. This book is intended for experimental physicists and for undergraduate and graduate students specializing in the fields of gas dynamics and plasma physics. (auth) (STAR)

34391 ELECTRON DENSITY AND RADIAL DISTRIBUTION MEASUREMENTS ASSOCIATED WITH THE INTERNAL RESONANCES IN A CURRENT-MODULATED PLASMA COLUMN. Burkley, C. J.; Sexton, M. C. (University Coll., Cork, Ireland). Int. J. Electron., 25: 517-28(Dec. 1968).

Microwave cavities were used to measure both electron densities and radial profile distributions in a current-modulated plasma column. A phase lag was shown to exist between the current and electron density with 50 HZ modulation. In addition, variations in the radial distribution were shown to account for previously recorded discrepancies in the locations of the internal (Tonks-Dattner) resonances as a function of modulated current. Although detailed results are presented for mercury and krypton plasmas only, similar effects were observed in argon and xenon. (auth) (UK)

34392 COLLECTIVE SCATTERING AT 90° OF LASER LIGHT BY A DENSE COLD PLASMA. Baconnet, Jean-Pierre; Cesari, Georges; Coudeville, Alain; Watteau, Jean-Paul (CEA, Limeil, France). Compt. Rend., Ser. B, 268: 1013-16(Apr. 14, 1969). (In French).

The collective scattering at 90° to the light of a ruby laser by a cold dense deuterium plasma produced by an electric discharge is observed. From the electron component of the spectrum the density and the electron temperature of the plasma are deduced. (tr-auth)

34393 MASS-SPECTROMETRIC INVESTIGATIONS OF COLUMN PLASMA OF HYDROGEN LOW-PRESSURE GLOW DISCHARGE. Schmidt, Martin (Institut fuer Gasentladungsphysik, Greifswald, Ger.). Beitr. Plasmaphys., 9: 11-27(1969). (In German).

The results of mass-spectrometric investigations of the charge carrier occurring in the region of the positive column of a hydrogen low-pressure glow discharge (R = 1.5 cm, p = 1.5 torr, I = 5 to 70 mamp) from a small opening (d = 39 μm) in the tube wall were reported. In addition to the dominating H_3^+ and H^+ ions, a small H_2^+ component could be detected. In the negative wall current, only electrons are found. By use of the experimentally determined electron temperature, gradients, and wall temperatures, the ambipolar wall current density was calculated according to Pahl. The concentration ratios of the ions (H^+, H_2^+, H_3^+) and neutral gas components (H, H_2) were determined over a carrier balance. By comparison of the electron temperature necessary for guaranteeing the carrier balance with the value determined from the probe measurements, it was concluded that an energy balance with a deficit in fast electrons with respect to Maxwell distribution is present. A formulation of the energy balance shows the high-energy consumption for the oscillation excitation and dissociation of the water molecule. (tr-auth)

34394 APPARATUS FOR ION TEMPERATURE MEASUREMENT. (to Japan Atomic Energy Research Inst.). British Patent 1,157,147. July 2, 1969. Priority date Oct. 27, 1965, Japan.

The invention provides the method of measuring the ion temperature of streaming plasma which comprises feeding a reversible pulsed or dc voltage to two identical metal electrodes arranged so one electrode is downstream of the other with the plane containing the two electrodes parallel to the direction of the flow of the plasma and determining the ion temperature from the asymmetry of the voltage-current characteristic of the double probe. (M.O.W.)

34395 SPECTROSCOPIC MEASUREMENTS OF WEAKLY IONIZED ARGON PLASMA JET. II. SPECTROSCOPIC MEASUREMENT OF WEAKLY IONIZED ARGON PLASMA FLOW PREMIXED WITH N_2 IN PLENUM CHAMBER. Kamimoto, Goro; Shirai, Hiroyuki (Kyoto Univ.). Nippon Koku Gakkaishi, 17: No. 183, 16-25(Apr. 1969).

The properties of weakly ionized argon plasma flow premixed with N_2 in the plenum chamber are studied by the spectroscopic technique. A preliminary study is made of the physical processes occurring in the plenum chamber, and it is demonstrated that competitive reactions of the ground-state nitrogen molecule, free electron, and ground-state argon atom for metastable argon atom play an important role in the possible reactions. The rotational temperatures using the N_2 second positive (0,0) band are also measured, taking account of the overlapping of P and R branches, and it is found that electron temperature is about twice as large as the rotational temperature. Such a measurement of the free stream in the test section is very difficult because of the lack of the knowledge of the excitation mechanism from $X^1\Sigma$ state of N_2 to $C^3\Pi$ by the metastable Ar atom. (NSA of Japan)

34396 COMPARATIVE STUDY OF A HIGH-FREQUENCY SPHERICAL PROBE AND A LANGMUIR PROBE IMMERSED IN A CESIUM PLASMA IN THE COLLISIONAL REGION. Peureux, Jean-Marie (Laboratoire de Physique des Milieux Ionises, Nancy). Compt. Rend., Ser. B, 268: 1064-7(Apr. 21, 1969). (In French).

Electron density measurements on a cesium plasma in the collisional region were made. These results, obtained by the method of a spherical Langmuir probe and by a spherical high-frequency probe usable up to 200 MHz, are compared. The agreement is satisfactory if one considers that in the neighborhood of the plasma potential the spherical probe, with non-negligible dimensions in relation to the mean free path of electrons, is surrounded by a sheath in the midst of which the collisions are less numerous. (tr-auth)

Kinetics (General)

Refer also to abstract 34564.

34397 (AD-683685) INVESTIGATIONS OF IONIC SPECIES IN HIGH PRESSURE CESIUM DISCHARGES. Annual Report No. 3, March 1, 1968-February 28, 1969. Chanin, L. M. (Minnesota Univ., Minneapolis. Inst. of Tech.). Feb. 28, 1969. Contract N00014-67-A-0113. 32p. CFSTI.

Measurements are reported of the ionic species present in active discharges of argon and cesium. The discharges were created using rf and dc excitation. A simple plasma model is used to account for the observed ion current signals. (auth) (USGRDR)

34398 (AD-685124) INVESTIGATIONS OF A STREAMING PLASMA IN AN AXIAL MAGNETIC FIELD. Young, Eddie H. Jr.; Duesterhoeft, W. C. Jr. (Texas Univ., Austin. Plasma Research Lab.). Aug. 20, 1968. 131p. (TR-55; AFOSR-68-1878). CFSTI.

The purpose of this report is to study both theoretically and experimentally the behavior of a pulsed plasma streaming in a longitudinal magnetic field. (auth) (USGRDR)

34399 (CONF-680113-(Vol.4)) 2nd INTERNATIONAL CONFERENCE ON THE INTERACTIONS BETWEEN OSCILLATING FIELDS AND PLASMAS, SACLAY, FRANCE, JANUARY 15-19, 1968. VOLUME IV. EQUILIBRIUM AND STABILIZATION PROBLEMS. (Institut National des Sciences et Techniques Nucleaires, Saclay (France)). 222p. (In French and English). Dep.

Separate abstracts were prepared for the 11 included papers. (M.O.W.)

For abstracts of individual papers see: 34364, 34372, 34373, 34447-34453, and 34475.

34400 (ORNL-4401, pp 113-44) PLASMA PHYSICS. (Oak Ridge National Lab., Tenn.).

ELECTRIC DISCHARGES—plasma stabilization in Penning, electron transport, (E/T)
ION ACOUSTIC WAVES—propagation and damping in plasmas, properties of, (T)
PLASMA—wave damping in xenon in uniform magnetic fields, Landau, (T)
—wave potential and density perturbations from, ion acoustic, (T)
—wave focusing in, ion acoustic, (E)
—wave propagation in, wavelength calculation for ion acoustic (T)
—wave propagation in magnetic fields, dispersion relations for electrostatic ion, (E)
—wave propagation in, pseudowaves, (E/T)
—boundary sheaths in, transient and Langmuir, (E/T)
—production in magnetic fields, using electron guns and resonant microwaves, (E)
—diagnostics using ion energy analysis and laser interferometers, (E)
—stabilization in Penning discharges, electron transport, (E/T)
XENON—plasma of, Landau damping of electrostatic ion waves in uniform magnetic fields (T) (M.O.W.)

34401 (UCRL-50583) WAZER: A ONE-DIMENSIONAL, TWO-TEMPERATURE HYDRODYNAMIC CODE. Kidder, Ray E.; Barnes, William S. (California Univ., Livermore. Lawrence Radiation Lab.). Jan. 31, 1969. 26p. Dep. CFSTI.

The physics and mathematics used in the computer code WAZER are described. This code can perform calculations on plasmas which involve thermal diffusion, heat transfer between ion and electron populations, heat loss from the electrons due to radiation, hydrodynamic effects, absorption of laser light, fusion, and loss of energy across the boundaries in the form of either heat or work. The description includes the mathematical formulation of the physical laws involved and the differencing techniques used to solve the partial differential equations of heat transport and hydrodynamic motion. (auth)

34402 COEFFICIENT OF CONTINUOUS ABSORPTION OF HYDROGEN-CARBON PLASMA AT 40,000°K AND 70 ATM. Belov, S. N.; Ogurtsova, N. N.; Podmoshenskii, I. V. Opt. Spectrosc. (USSR) (Engl. Transl.), 25: 383-5(Nov. 1968).

Translated from Opt. Spektrosk., 25: 684-8(Nov. 1968).

The spectral coefficient of continuous absorption of hydrogen-carbon plasma at T = 40,000°K and pressure of 70 atm was measured in the 230 to 460-nm region. The continuous absorption was calculated for these experimental conditions using formulas by Biberman and Norman. The results of the calculation are compared with the experimental data. It is shown that transitions between broadened discrete levels make a substantial contribution to the emission of a dense plasma. (auth)

34403 MIXING IN ARGON-MERCURY MEDIUM PRESSURE DISCHARGE. Babucke, Gerhard (Physikalisch-Technische Institut, Berlin). Beitr. Plasmaphys., 9: 1-10(1969). (In German).

The known balance equations for the description of the axial mixing in nonisothermal column plasma were generalized by consideration of the radial variation of the neutral gas temperature and applied to the diagnosis of a 50-torr argon discharge with mercury vapor admixture. The data obtained permit conclusions on the electron mobility in pure argon at electron temperatures up to 9000°K. (tr-auth)

34404 STARK BROADENING OF CARBON I SPECTRAL LINES IN AN ARC PLASMA. Nubbemeyer, H.; Wende, B. (Physikalisch-Technische Bundesanstalt, Berlin). Z. Phys., 225: 69-75(1969). (In German).

The half widths of Stark-broadened C I spectral lines measured in a wall-stabilized arc plasma were compared with theoretical half widths according to Griem. Within the errors of Griem's line-broadening calculations of about 20%, there was agreement between experimental and theoretical half widths for all measured spectral lines with known calculated broadening parameters. (auth)

34405 IONIC CURRENT IN THE CENTER OF A CATHODE IN A DISCHARGE WITH OSCILLATING ELECTRONS IN A MAGNETIC FIELD. Reikhrudel, E. M.; Smirnitskaya, G. V.; Nguyen Hui Ti. Vestn. Mosk. Univ., Ser. III. Fiz.-Astron., No. 2, 52-8 (Mar.-Apr. 1969). (In Russian).

The ion current and angular distribution of ions, which travel in the center of the cathode, in oscillating electron discharges at different values of the parameters were theoretically and experimentally investigated. The angle of dispersion of the ion beam for different discharge regimes was determined. In regime 1 (weak H) the focusing of ions is determined by the action of the radial electric field. In regime 2 (strong H) the decrease of ionization near the discharge axis and the action of the magnetic field on the ion trajectory leads to appearance in the center of cathode of an unmelted part; the radius of this part was calculated. (tr-auth)

Kinetics (Experimental)

Refer also to abstracts 34267-34269.

34406 (AD-682306) RESEARCH DIRECTED TOWARD UNDERSTANDING BEHAVIOR AND DETECTION OF PLASMAS IN MAGNETIC FIELD. Final Report, November 1, 1967-October 31, 1968. Finkelstein, David (Yeshiva Univ., New York. Belfer Graduate School of Science). Nov. 30, 1968. Contract F19628-68-C-0161. 16p. (AFCRL-68-656). CFSTI.

The physics of high-voltage, large-current plasma discharges is summarized. Discharges with currents large enough for magnetic field effects to be prominent (>100,000 A) and voltages large enough for relativistic effects to be appreciable (>1,000,000 V) were studied. Towards this end, the emphasis during this period was placed on reliable diagnostic techniques. 1-MV electric field probes, 1-MA current probes, and a double-exposure holographic optical probing system were developed. The elements of the discharge apparatus are reviewed, and the diagnostic methods are described. In addition, a study of the structure of ball-lightning was concluded and the pertinent results are presented. (auth) (USGRDR)

34407 (AD-682992) EXPERIMENTAL INVESTIGATIONS OF RADIO FREQUENCY PLASMOIDAL DISCHARGES. Final Report. Miller, A.; Bruce, C. W.; Lehman, T. H. (New Mexico State Univ., University Park). Sept. 1968. Contract Nonr-3531(03). 74p. CFSTI.

Utilization of a positive ion beam as a potential probe has provided data on the static potential distributions within rf discharges generated at pressures below 0.001 torr. Analysis of the data, based on assumptions of essential one-dimensionality of the fields, has led to improved knowledge of not only the potentials, but also the electric field strengths and charge densities. Spectroscopic studies of pulsed discharges have indicated regions of discharge instability, the precise descriptions of which are not presently available. Some details of the observations on the buildup times of low-pressure discharges are reported. A brief description of a recent hypothesis regarding the nature of the "dark sheath" in certain rf plasmoidal discharges is included. (auth) (USGRDR)

34408 (CNEA-225) MECHANISM OF THE DISCHARGE IN GASES IN THE REGION OF SUBNANOSECONDS. D'Alessio, J. T.; Lanza, H. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1968. 22p. (In Spanish). Dep.

The spark generation mechanism in pressurized gas, which leads to light and electrical pulses of the order of the subnanosecond (10^{-10} sec), was analyzed. The classical formation mechanism of the plasma by means of regenerative processes by

photons and other causes, produced during the avalanche phenomenon, can not account for the production of 10^{11} electrons in 0.3 nsec, which are obtained experimentally by generators with hydrogen under 30 atm and electrodes of amalgated mercury or mercury-covered electrodes. The experimental results were interpreted by a model in which the equilibrium form of the liquid surface is made to intervene. The liquid surface is under the action of an electric field and surface tension which causes, in the region close to the electrodes, an electric field of 10^9 V/cm. With a field of this magnitude, electrons are produced at the cathode in sufficient number to explain the experimental results. The avalanche multiplication factor always increases enormously. According to this model, only with liquid electrodes in gases at high pressure and small distance between electrodes can pulses in the region of 10^{-10} sec be produced. The favorable influence of mercury vapor in the contamination of hydrogen was also analyzed. (tr-auth)

34409 (N-69-22920) EXPERIMENTAL INVESTIGATION OF THE SPECTRAL EMISSION CHARACTERISTICS OF ARGON–TUNGSTEN AND ARGON–URANIUM INDUCTION HEATED PLASMAS. Marteney, Pierre J.; Mensing, A. E.; Krascella, N. L. (United Aircraft Corp., Hartford, Conn.). Apr. 1969. Contract NASw-847. 48p. (NASA-CR-1314; G-910092). CFSTI.

An experimental study was conducted to determine the emission characteristics of gaseous tungsten and uranium located in an rf induction-heated, vortex-stabilized argon discharge. The tungsten and uranium were introduced into the discharge in the form of W and WF_6 or UF_6 at heavy atom-to-argon mass ratios and a total pressure of one atmosphere. Temperatures in the heavy-atom seeded discharges were determined to be approximately 8500°K, and were ascertained by measuring neutral argon atom relative line intensity ratios by the Boltzmann method. Temperatures determined by this method were confirmed by measurements of absolute neutral argon atom line intensities and absolute argon ion continuum intensities. Spectra were obtained for pure Ar, WF_6–Ar, and UF_6–Ar systems in the wavelength region from 125 A (0.125 μ) to 100,000 A (10 μ). The experimental data were reduced to obtain integrated continuum and line intensities over intervals of 100 A for pure argon. Integrated line intensities were obtained over wavelength intervals of 100 A for tungsten and uranium after correcting the experimental results for the contribution to total intensity due to argon continuum and lines. (auth) (STAR)

34410 (NP-17867) PROPAGATION OF WAVES IN PLASMA GUIDES. PART II. Leprince, Philippe (Paris Univ., Orsay (France). Laboratoire de Physique des Plasmas). June 1966. 123p. (In French). (LP-63). Dep.

A detailed experimental study was made of the dipolar mode. A method was developed for measurement of the density of a plasma column; this method has the advantage of being simple to use and, during the course of an experiment, enables the discharge density to be controlled. An experimental study of the resonances of a cavity containing a plasma showed coupling between the guide modes and the plasma modes. For the modes m = 1, the probable form of the Brillouin diagram for a guide containing a plasma was suggested. (tr-auth)

34411 (ORNL-4401, pp 145-59) TOROIDAL MULTIPOLES. Alexeff, I.; Dory, R. A.; Halchin, W.; Roberts, M.; Stirling, W. L. (Oak Ridge National Lab., Tenn.).

The following quadrupole experiments with a microwave-produced plasma are described: (1) comparison of dipole and quadrupole configurations, (2) comparison of first and second model quadrupole cavities, (3) electron temperature determination in the λ = 3 cm, 200-W microwave plasma, (4) change in heating zone, (5) obstacle experiments, (6) effects of introducing supports, (7) nature of the decay of the 3-cm microwave plasma, and (8) effect of azimuthal electric field on microwave plasma. Preliminary observations on combined operation of the hydrated titanium washer gun and microwave heating are described. (M.O.W.)

34412 (RISO-191) STUDIES OF A ROTATING-PLASMA DEVICE. Oester, Flemming (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar. 1969. 49p. Dep.

Measurements with a rotating-plasma device are reported. The device is of the open-ended type with a magnetic mirror and a solid-center electrode. A fast acting valve is used to inject the neutral gas into the machine. The equivalent capacity is measured, and agreement is found with the amount of gas injected. The energy density of the plasma is measured by means of diamagnetic loops located with the stainless-steel electrode between the plasma and the loops. A high-energy density is found only in a fraction of the time during which the voltage across the electrodes decays. Even in that short time interval the energy density is not as high as expected, but this discrepancy may be due to the measuring technique itself. The energy density loss mechanisms are not known. A review of relevant results obtained with similar devices is presented. (Denmark)

34413 MASS-SPECTROMETRIC PROOF OF THE EXISTENCE OF He_3^+ AND He_4^+ IONS. deVries, C. P.; Oskam, H. J. (Univ. of Minnesota, Minneapolis). Phys. Lett., 29A: 299-300(June 2, 1969).

Studies of the ionic composition of helium plasmas at gas temperatures near 80°K, using mixtures of ^{3}He and ^{4}He, confirmed the existence of He_3^+ and revealed the existence of He_4^+ at these temperatures. (auth)

34414 SUPRESSION AND PARAMETRIC AMPLIFICATION OF ION SOUND IN A PLASMA. Barkhudarov, E. M.; Kervalishvili, N. A.; Kortkhondzhiya, V. P.; Tsintsadze, N. L.; Tskhakaya, D. D. (Inst. of Physics, Tbilisi, USSR). JETP Lett. (USSR) (Engl. Transl.), 9: 163-5(Mar. 5, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 9: 278-81(Mar. 5, 1969).

The results are reported of an investigation of parametric amplification of ion-acoustic oscillations when a low-frequency electric field is applied to the plasma, as well as a number of data connected with the nonlinearity of the processes that occur in the plasma, namely the suppression of ion–acoustic oscillations and resonant amplification at the frequency $f = 3 f_0$, where f_0 is the frequency of the ion–acoustic oscillations. (M.O.W.)

34415 POSSIBILITY OF INVESTIGATION OF CHARGE PARTICLE VELOCITY DISTRIBUTION FUNCTION. Ivanov, B. I. At. Energ. (USSR), 25: 537-8(Dec. 1968). (In Russian).

Charged-particle distribution functions according to the longitudinal velocity and Doppler shift of the gyroresonance frequencies are discussed. The electron gyrofrequency ω_c relation to the Doppler effect was investigated in a system consisting of a multimode 10-cm-range resonator (height = 300 mm, diameter = 102 mm, $Q \approx 10^4$, and frequency 1700 to 3800 MHz) penetrated by pulsed electron beam (beam duration τ = 25 μsec, electron energy U = 1 to 12 keV, current I = 0 to 3 A, beam diameter of 10 mm). The resonator was excited by a klystron generator, and the longitudinal magnetic field intensity was 0 to 1500 Oe, inhomogeneity 2%. The electron concentration in the beam was ($n_0 \approx 10^8$ to 10^9 cm^{-3}) and in the plasma formed during ionization by the residual gas beam ($n \approx 10^7$ to 10^{10} cm^{-3}), which is below critical. Graphical data are analyzed. (R.V.J.)

34416 RADIATIVE TRANSPORT QUANTITIES FOR A HYDROGEN PLASMA. Mandell, D. A.; Cess, R. D. (State Univ. of New York, Stony Brook). J. Quant. Spectrosc. Radiative Transfer, 9: 981-94(July 1969).

The investigation was made in order to evaluate various radiative transport quantities for a hydrogen plasma. These transport quantities pertain to the analysis of radiative energy transfer in nonisothermal gases, and they include the Planck mean, modified Planck mean, linear Planck mean, and Rosseland mean absorption coefficients, in addition to the modified emissivity and its derivative which appear in the formulation for the linearized radiative flux. Twenty one spectral lines were included in the calculations, and the line profiles were taken to be Stark profiles. Results are presented for temperatures from 10,000° to 20,000°K and electron densities of 10^{16}, 10^{17}, and 10^{18} cm^{-3}. The importance of line radiation, relative to continuum radiation, and the practical achievement of the optically thin and optically thick limits, are discussed. (auth) (UK)

34417 EFFECT OF EXTERNAL HIGH-FREQUENCY MODULATION OF THE ELECTRON BEAM ON ENERGY AND TEMPERATURE OF ACCELERATED PLASMA ELECTRONS AT BEAM INSTABILITY. Kornilov, E. A.; Lifshits, E. V.; Kovpik, O. F. (Inst. of Physics and Technology, Kharkov). Ukr. Fiz. Zh., 14: 575-84(Apr. 1969). (In Russian).

Experimental investigation of electrons accelerated to high energy under conditions of plasma-beam discharge in the presence or absence of external modulation of an injected beam showed that there is a stochastic mechanism of plasma electron acceleration. External high-frequency modulation causes not only spectrum narrowing of high-frequency oscillations and quenching of low-frequency ones, but also an essential redistribution of the energy between plasma electrons. In particular, modulation lowers the electron temperature (60 to 80 eV without the external modulation; 40 to 50 eV in the presence of modulation) and increases the energy of a high-energy group of electrons with a decrease in their total number (energy with modulation grows from 15 to 20 keV to 40 to 80 keV, particle number decreases by 5 to 10 times). High-energy electrons at modulation can be observed only in reso-

nance regions $\omega_{mod} \approx n\omega_{He}$. Conditions of such a resonance are similar to those of the existence of cyclotron absorption of beam-induced waves by plasma electrons. (auth)

34418 MEASUREMENTS OF THE POTENTIAL DISTRIBUTION IN A CASCADE ARC. Uhlenbusch, J.; Gieres, G. (Technische Hochschule, Aachen). Z. Angew. Phys., 27: 66-8(May 5, 1969). (In German).

The radial potential distribution inside the plasma of a cascaded arc burning at 50 amperes in argon was measured by electric probes in the plasma for a short time. The potential was determined by the voltage–current characteristics of the probe. A well-shaped distribution of the potential was found. The depth of the well is 8.6 V and extends about 4 diameters of the cascaded arc. (auth)

34419 ELECTRON–ION RECOMBINATIONS IN A DENSE HYDROGEN PLASMA. Funahashi, Akimasa; Takeda, Susumu (Nagoya Univ., Japan). J. Phys. Soc. Jap., 27: 182-6(July 1969).

Measurements of electron densities and temperatures were performed in a plasma produced behind an electromagnetically driven, reflected shock wave in a T tube filled with hydrogen at an initial pressure of 1.0 torr. The ranges of the measured electron densities and temperatures are from 10^{17} to 10^{15} cm^{-3} and 2.5×10^4 to 10^4°K, respectively. The electron densities are determined by the 35-GHz microwave reflection technique. These measured values are in good agreement with those determined from Stark broadening of the Hβ line. The electron temperatures are determined from the ratio of the total spectral line to continuum intensity and from the measured collision frequency and electron density. The observed plasma decay is interpreted in terms of the collisional–radiative electron–ion recombination theoretically calculated by Bates, Kingston, and McWhirter, who take account of the effect of the ionization. (auth)

34420 ELECTRON ACCELERATION BY LOCAL ELECTRON CYCLOTRON RESONANCE. Abe, Haruhiko; Sugawa, Masao; Terumichi, Yasushi; Tanaka, Shigetoshi (Kyoto Univ.). J. Phys. Soc. Jap., 26: 1507-13(June 1969).

Electron acceleration by the local electron cyclotron resonance of the nonuniform microwave and static magnetic fields was investigated. The spatially varying microwave field is generated by (a) a standing wave in a waveguide, (b) a standing wave along a Lecher line and (c) a microwave field perpendicular to a Lecher line, respectively. In these configurations, the maximum acceleration of electrons is made with the local cyclotron resonance at the position of maximum microwave field, only when the magnetic field is decreasing in the direction of electron drift. Further, when the electron beam is accelerated, its energy distribution is spread out, compared with that in the case of no acceleration. (auth)

34421 INSTABILITY NEAR ELECTRON CYCLOTRON HARMONIC FREQUENCIES IN BEAM–PLASMA SYSTEM. Idehara, Toshitaka; Ohkubo, Kunizo; Tanaka, Shigetoshi (Kyoto Univ.). J. Phys. Soc. Jap., 27: 187-97(July 1969).

When a weak electron beam is injected into a plasma in thermal equilibrium, instabilities appear that result in the excitation of the following waves; (i) electrostatic cyclotron harmonic waves (CHW), (ii) the upper hybrid resonance wave, (iii) fine structure near the cyclotron harmonic frequencies, (iv) harmonic waves of half the cyclotron frequency and (v) quasi-longitudinal (QL) low-frequency waves. The intensity of the microwave emission resulting from these instabilities is very strong and is larger by several tens of db than that emitted from the plasma in the absence of the electron beam. The excitation of CHW is ascribed to the interaction of CHW in plasma with those in the electron beam. The fine structure is due to the standing waves of CHW confined in the plasma column. The instability in the lf range is ascribed to a coupling of the QL waves in the plasma with the space charge waves in the beam. (auth)

Kinetics (Theoretical)

34422 (AD-683347) TRANSPORT PROPERTIES OF TWO-TEMPERATURE PARTIALLY IONIZED PLASMAS. Daybelge, Umur (Stanford Univ., Calif. Inst. for Plasma Research). Dec. 1968. Contract F44620-68-C-0051. 153p. (SU-IPR-263; AFOSR-69-0382TR). CFSTI.

A simplification of the Chapman–Enskog method for the calculation of transport properties of two-temperature, partially ionized gas mixtures in a magnetic field is presented. The simplification is achieved by exploiting the fact that the electron mass is much smaller than that of any other constituent of the gas. A systematic study is presented of the tensor coefficients for the electron electrical conductivity, thermal conductivity, and thermal diffusion. The interplay between the degrees of ionization and magnetic field in determining the sign of the transverse electron thermal diffusion coefficient has been examined. Simple formulas for the thermal diffusion coefficients in the presence of magnetic field have been obtained. The unified theory of Kihara and Aono for charged-particle interactions was applied to obtain improved values of the transport coefficients when the number of particles in a Debye sphere is not large. These have been compared with theories based on a cutoff Coulomb potential, and on a shielded-Coulomb potential. It was found that the unified theory and the shielded-Coulomb theory are in close agreement. Mixture rules were given for all three transport coefficients, including the case when there is a magnetic field present. Simplifications introduced into the Chapman–Enskog method were also demonstrated in obtaining the transport coefficients of the heavy particles of a three-component, two-temperature plasma. (auth) (USGRDR)

34423 (AEC-tr-7049) ENERGY CONSUMPTION, ELECTRICAL CONDUCTIVITY AND DIELECTRIC CONSTANT OF CHARGED PARTICLES IN ELECTRIC AND MAGNETIC FIELDS. Kelm, S. (Deutsche Versuchsanstalt fuer Luft- und Raumfahrt e. V., Stuttgart (West Germany)). Translation of report DLR-FB-67-37. 43p. Dep. CFSTI.

The drift velocity of electrons and ions of a plasma in an electric and magnetic field is calculated. From this, the mean electrical energy of the charged particles as consumed within the free-flight period is determined in the stationary state. The electrical conductivity is calculated from the charged-particle velocity and the dielectric constant from the conductivity by simple formulas. In certain cases, the conductivity and dielectric constant become tensors. Consumed energy, conductivity and dielectric constant are represented as functions of electric field strength and its frequency, collision frequency, magnetic field frequency, and cyclotron frequency. The electric and magnetic fields may be constant or alternating in time, or they may propagate spatially as traveling waves. (auth)

34424 (N-69-21124) THEORETICAL INVESTIGATION OF THE COMPOSITION AND LINE EMISSION CHARACTERISTICS OF ARGON–TUNGSTEN AND ARGON–URANIUM PLASMAS. Krascella, N. L. (United Aircraft Corp., East Hartford, Conn.). Mar. 1969. Contract NASw-847. 76p. (NASA-CR-1313; G-910092-10). CFSTI.

A theoretical investigation was conducted to determine the composition and integrated line emission characteristics of various ionization species of tungsten, uranium, and argon. The study was made to facilitate radiant heat-transfer analysis in the seeded propellant and nuclear fuel regions of gaseous-core nuclear rocket engines and to provide a basis of comparison for a concurrent experimental program designed to examine line emission characteristics of gaseous tungsten and uranium over a wide spectral range. Estimates were made of the composition as a function of temperature for mixtures of Ar with WF_6 and UF_6 using an existing UARL machine composition program to ascertain the decomposition products of WF_6 and UF_6. Integrated line intensities summed over wavelength intervals of 100 Å were calculated in the spectral region between wavelengths of 1700 and 10,000 Å. W-to-Ar or U-to-Ar mass ratios of 1.0×10^{-3}, 1.0×10^{-5}, and 1.0×10^{-7} were considered at temperatures of 5000, 7000, and 9000°K. (auth) (STAR)

34425 (N-69-22149) TEST PARTICLE METHOD IN KINETIC THEORY OF A PLASMA. Matsuda, Kyoko (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Mar. 1969. 30p. (NASA-TM-X-63505; X-641-69-103). CFSTI.

A general relationship was found between many-body correlation functions and the conditional probability functions which describe the shield clouds surrounding test particles. Based on the principle of superposition, the relationship is useful because the problem of kinetic theory is reduced to determining the conditional probability functions, which involves essentially only the Vlasov equation. This method was applied to obtain a second-order correction to the Lenard–Balescu collision integral. (auth) (STAR)

34426 (N-69-22195) STUDY OF TRANSPORT PROPERTIES AND DISTRIBUTION FUNCTION DYNAMICS IN ONE DIMENSIONAL PLASMA MODELS. Final Report. Coon, Jesse B. (Texas Agricultural and Mechanical Univ., College Station. Dept. of Physics). Mar. 20, 1969. 42p. (NASA-CR-100577). CFSTI.

The resonances in a one-dimensional, two-component, nonuniform sheath-bounded plasma were studied. The numerical experiment was performed on a Univac 1108 computer, using a one-dimensional charge-sheet model system, driven by oscillating electric fields of various frequencies. The time-varying current was Fourier-analyzed to obtain the frequency dependence.

No relation was found between the first resonance frequency and the average plasma frequency. The sheath strength appears to influence the resonances; the plasma behaves differently for a weaker sheath. Numerically exact solutions of the one-dimensional Lenard–Balescu equation for drifted plasmas were also carried out. The computer program was developed on an IBM 7094; data were obtained from runs on a Univac 1108, and curves were plotted by the SC 4020. Detailed results of the study are discussed. The validity of the drifted-distribution assumption and the effects of the wave–particle interactions on the time development of the distribution function are examined. Investigations concerning the effects of gross spatial inhomogeneities on the growth rate of instabilities are also reported. (STAR)

34427 (N-69-22638) THEORETICAL INVESTIGATIONS OF r-f INDUCTION HEATED PLASMAS. Mensing, Arthur E.; Boedeker, Laurence (United Aircraft Corp., East Hartford, Conn.). Apr. 1969. Contract NASw-847. 79p. (NASA-CR-1312; G-910091-18). CFSTI.

Theoretical analyses were made to investigate the power deposition and energy removal in rf induction-heated plasmas. These investigations were directed toward the high-power, high-pressure, radiating rf plasmas that are being used to simulate the thermal environment of the nuclear light bulb reactor. Two related investigations are described in this report. In one, the power-deposition and energy-dissipation characteristics of infinite-cylinder rf-heated argon plasmas at pressures of 1.0 and 10 atm were studied. The electromagnetic field equations, energy equation, and heat-conduction equation were integrated numerically, starting with specified values of temperature and axial magnetic field at the centerline. In the second investigation, the coupling between the plasma discharge and the rf generator was studied, using an infinite-cylinder, constant-conductivity model. The analysis was used to investigate the effects of discharge power, reactive power, and discharge size on the surface radiation heat flux and to examine the effect of rf frequency shifts on matching. (auth) (STAR)

34428 (N-69-22895) ROLE OF LANDAU DAMPING IN CROSSED-FIELD ELECTRON BEAMS AND INVISCID SHEAR FLOW. Briggs, R. J.; Daugherty, J. D.; Levy, R. H. (Avco-Everett Research Lab., Everett, Mass.). Dec. 1968. Contracts NAS8-21392; AT(30-1)-3863; AF49(638)-1553. 77p. (NASA-CR-98387; RR-317). CFSTI.

The electron density, the drift velocity, and the potential correspond to the fluid vorticity, velocity, and the stream function, respectively. The analogy is valid only for waves propagating in the direction of the unperturbed velocity. Neutrally stable normal modes of oscillation that are found when certain suitable step-function unperturbed electron density (vorticity) profiles are assumed seem to disappear when small gradients are present. In the context of a Laplace transform, solution of the initial-value problem, the vanishing normal modes can be found by analytic continuation of the solution onto another sheet of the cut complex ω-plane. The recovered modes are found to be damped by a fluid-wave resonant interaction which closely resembles the Landau damping of plasma oscillations in warm plasmas by particle–wave resonance. An interesting feature of the neutral waves is that they have a negative energy and so are destabilized by the removal of energy from the system (for example, by slightly dissipative walls). (auth) (STAR)

34429 (ORNL-4401, pp 1-24) PLASMA THEORY AND COMPUTATION. (Oak Ridge National Lab., Tenn.).

MAGNETIC MIRROR MACHINES—plasma diamagnetic equilibrium in ELMO
PLASMA—wave propagation in, Brillouin diagram solutions of real dispersion relation for, (T)
—wave propagation in, growth rates of flutelike loss-cone modes in, (T)
—stability of multicomponent, flutelike gyroharmonic, (T)
—stability of, nonlinear explosive, (T)
—stability of hot-electron, micro-, (T)
—waves in beam-plasma system, unstable, (T)
—kinetics of, numerical simulation of, (T)
—stability in magnetic mirror ELMO facility, diamagnetic, (T) (M.O.W.)

34430 (SC-R-69-1270) PLASMA EXPANSION INTO A VACUUM ENVIRONMENT. Mangan, D. L. (Sandia Labs., Albuquerque, N. Mex.). Apr. 1969. 32p. Dep. CFSTI.

The problem of plasma expansion into a vacuum is studied. The problem is stated as follows: Given a finite point source of plasma determine the number density and the electric field as a function of space and time. (M.O.W.)

34431 DETERMINATION OF THE STATIONARY STATES OF A PLASMA IN AN OSCILLATING ELECTROMAGNETIC FIELD. Samain, Andre (EURATOM–CEA, Fontenay-aux-Roses, France). Compt. Rend., Ser. B, 268: 1009-12(Apr. 14, 1969). (In French).

A variational method is presented for determining the stationary states of a collisionless plasma in an electromagnetic field. This method is applied to whatever may be the structure of the static and oscillating components of the field, assuming that the particles can be described by angular variables and an operation introduced previously. (tr-auth)

34432 STATE OF MATTER UNDER VERY HIGH PRESSURES AND TEMPERATURES. Geiger, W.; Hornberg, H.; Schramm, K. H. (Battelle-Institut e.V., Frankfurt am Main). pp 1-52 of Springer Tracts in Modern Physics. Vol. 46. Hoehler, G. (ed.). Berlin, Springer-Verlag, 1968. (In German).

The state of matter is discussed for pressures up to 17 atm and temperatures up to $\sim 10^8$°K. At sufficiently high pressures, the Thomas–Fermi statistical theory of the atom may be used; the original theory is generalized and extended to higher temperatures. Numerical results for a wide range of pressures and temperatures are listed, and may be used for evaluation of the thermodynamic functions of matter with arbitrary atomic number; this procedure is demonstrated in the special cases of argon and hydrogen. Considerable effort is devoted to defining and developing the concepts of "classical" and "strongly compressed" plasmas. 30 references. (TSS)

34433 THE STABLE, LYAPUNOV-TYPE, EQUILIBRIUM DISTRIBUTION OF CHARGED PARTICLES IN AN IONIZED-GAS CLOUD. Temko, S. V. Zh. Prikl. Mekh. Tekh. Fiz., No. 1, 20-6(Jan.-Feb. 1969). (In Russian).

The equilibrium spatial distribution of charged particles, within a cloud of ionized particles having a given shape and dimensions, was determined. The problem represents a smoothed Coulomb interaction of the particles within the gas. It was assumed for the calculation that the gas cloud possessed a rotation ellipsoidal form; only the accumulated charged particles which were stable, as indicated by Lyapunov, were considered; the specific rotation of the cloud around one of the axes of the ellipsoid was neglected. An expression was obtained for the stored threshold energy of the ionized gas for a given degree of ionization of the neutral gas and for the pressure and chemical potential of the ionized gas. The author's earlier method of calculation was used to solve the problem on the basis of the available experimental data. (TTT)

34434 AN ELECTRIC ARC IN A HYDROGEN STREAM AT HIGH PRESSURES. Vetlutskii, V. N.; Sevast'yanenko, V. G. Zh. Prikl. Mekh. Tekh. Fiz., No. 1, 136-8(Jan.-Feb. 1969). (In Russian).

The interaction of an electric arc with a laminar hydrogen stream at a pressure of 100 atm. was examined, taking into account the transversal overflow. The current density of the system was 30 A.; the tube radius was 0.3 mm. As no data are available on the velocity and temperature profile in a plasmatron operating at such a high pressure, a parabolic longitudinal velocity profile was chosen, varying the temperature profile. The calculations indicated that the temperature affects only slightly the parameters. It was concluded that under the conditions used, radiation plays the determining role in the heat-transfer process. The transversal component increases strongly in the current-carrying region; the longitudinal component increases somewhat but remains nearly parabolic. (TTT)

34435 THEORY OF THE IDEAL ELECTRIC ARC IN A COAXIAL PLASMATRON WITH AN AXIAL MAGNETIC FIELD IN THE PRESENCE OF A GAS STREAM. Uryukov, B. A. Zh. Prikl. Mekh. Tekh. Fiz., No. 1, 138-43(Jan.-Feb. 1969). (In Russian).

The interaction of an electric arc with an axial magnetic field in a coaxial plasmatron is simpler than in a plasmatron with vortical stabilization of the arc, but even so, the shape of the arc and its rotational velocity may be solved analytically only if there is no longitudinal gas flow. This problem was considered by calculating the idealized behavior of the arc, neglecting shunting effects and phenomena taking place in front of the electrodes, in order to evaluate the effect of the current, magnetic field strength, flow velocity of the gas and geometric dimensions of the plasmatron on the arc voltage. Under the assumptions used, the volt–ampere features assume a descending character. In a coaxial plasmatron, an ascending volt–ampere relationship appears to be possible. If the magnetic field is zero, the coaxial plasmatron degenerates into one with a longitudinal blowout of the arc. Increase of the magnetic field results in the shortening of the arc. (TTT)

34436 DIELECTRIC FUNCTION AND MAGNETIZATION WAVES IN HIGH MAGNETIC FIELDS. Benford, Gregory (Univ. of California, Livermore); Rostoker, Norman. Phys. Rev., 181: 729-33(May 10, 1969).

The appropriate equilibrium Wigner distribution function is calculated for a quantum plasma of electrons with spin index σ, in high magnetic fields such that $\hbar\omega_c \approx E_F$. The quantum Vlasov equation is solved for the linear response, and there results a new form of the dielectric function $D(k,\omega)$ which is convenient for expansion in powers of $k_\perp^2$. It is then shown that ordinary density fluctuations produced by a longitudinal wave will be accompanied by large-amplitude magnetization waves when the quantum plasma is in its lowest state, $n = 0$, $\sigma = -1$. (auth)

34437 "RENORMALIZED QUASILINEAR THEORY" FOR THE WEAKLY TURBULENT PLASMA TAKING INTO ACCOUNT THE DISCRETENESS OF MATTER. Hatori, Tadatsugu (Tokyo Univ.). J. Phys. Soc. Jap., 27: 203-18(July 1969).

Under the assumption that the system is spatially uniform and the constituent particles interact only with scalar potential, the most general kinetic equation is derived based upon the Klimontovich formalism. Both the turbulent fluctuations and the fluctuations due to the discreteness of matter are taken into account. The equation obtained reduces to the ordinary equation applicable to the system nearly in equilibrium and also to the equation describing the Vlasov turbulence. The terminology "renormalized" means that partial summation of the perturbational expansion is performed in the derivation process. (auth)

34438 FLOWS OF A WEAKLY IONIZED GAS BETWEEN PARALLEL COLD WALLS. Shioda, Susumu (Tokyo Shibaura Electric Co., Ltd., Kawasaki, Japan). J. Phys. Soc. Jap., 27: 197-202(July 1969).

Ambipolar diffusion between parallel cold walls in the weakly ionized gas which flows in the direction parallel to walls is investigated theoretically. The whole volume is divided into linear, nonlinear, and sheath regions where linear diffusion equations, continuum equations containing inertia terms, and collisionless equations are used, respectively. Solutions are presented, and Bohm's criterion is used to match the nonlinear and sheath regions. The thickness of the nonlinear region is $O(\alpha^{1/4})$. The density of electrons and ions decreases to a fraction of $O(\alpha^{1/4})$ at the sheath edge. And the potential drop between the center and the walls is $O(-1/2\ kT_e/e \ln \alpha^{-1})$. ($\alpha \sim l_i^2/L^2$; l_i is the mean free path of the ions and 2L is the distance between walls). (auth)

Production

34439 (AD-679663) STUDY OF ARC-PLASMATRON OPERATION. Tkhomirov, V. B.; Varlamov, V. Translated by E. Harter from Inzh.-Fiz. Zh., 7: No. 6, 16-19(1964). 12p. (FTD-HT-23-1361-67). CFSTI.

An approximation method of computing plasma temperature in the channel of an arc plasmatron is discussed. Comparisons are made of the results of the computation for some systems of working with experimental data in accordance with the losses in the channel and direct measurements of the temperature by the spectral method. Results of experimental study of the distribution of the current in the channel of the plasmatron are presented. (USGRDR)

34440 (AD-683171) IONIZATION OF MEDIA AND CREATION OF PLASMA WITH HELP OF LASER RADIATION. Askaryan, G. A.; Rabinovich, M. S. Translated from Tr. Fiz. Inst., Akad. Nauk SSSR, 32: 89-96(1966). 18p. (FTD-MT-24-42-68). CFSTI.

Works dedicated to the investigation of the possibility of using laser radiation to solve such problems of plasma physics as ionization of media, creation of sterile plasma, heating of dense plasma, filling of plasma traps, and strong influence on atoms and molecules. (USGRDR)

34441 (NP-tr-1790) IONIZATION BY ULTRAVIOLET RADIATION EMITTED FROM A LASER PRODUCED PLASMA. Arifov, T. U.; Askaryan, G. A.; Tarasova, N. M. Translated from Zh. Eksp. Teor. Fiz., 56: 516-21(1969). 10p. (CTO-609). Dep. CFSTI.

Experimental investigations are described of the ionizing effect of uv radiation emitted by the action of a focused laser beam on a target. It is shown that even for moderate laser powers the ultraviolet radiation can, with a high degree of probability, ionize the atoms and molecules of a gas, especially near the focus. This opens up new prospects for producing highly ionized plasmas by bombarding a pellet, target or gas with a laser. Microwaves, probes, and a luminophor have been used as diagnostic means for investigating the ultraviolet radiation and the ionization produced. Experiments are described on the focusing of the uv radiation by polished metallic mirrors. It is shown that these can be used to produce regions of intense radiation. The results are applicable not only to the production of laser plasmas but also for photodissociation, excitation of atoms, production of polarized electrons from polarized atoms, and in various experiments, to study the effect of concentrated ultraviolet radiation on matter and organisms. (auth)

34442 PROCESS FOR PRODUCING BURSTS OF PLASMA AND APPARATUS FOR PUTTING THIS PROCESS INTO USE. Prevot, Francois (to Commissariat a l'Energie Atomique). British Patent 1,153,599. May 29, 1969. Priority date Sept. 3, 1965, France.

A continuous stream of particles in a condensed state is introduced into a first region, interrupting the stream to form sections of particles and passing the sections, in succession, to a second region in which a pulsed laser beam is focused on them, the first and second regions being maintained under vacuum. (M.O.W.)

Stability

Refer also to abstract 34375.

34443 (AD-683352) GROWTH RATE OF INSTABILITIES IN STRATIFIED PLASMAS. Herrnegger, F. (Innsbruck Univ. (Austria). Institut fuer Theoretische Physik). Dec. 30, 1968. Contract F61052-67-C-0014. 15p. (UNICP-SR-63; AFOSR-69-370TR). CFSTI.

Effects of a discontinuous, inhomogeneous magnetic field and gravitational effects on the growth rate of Kelvin-Helmholtz instabilities in inhomogeneous plasmas within the framework of ideal MGD are investigated. It is shown that an increasing nonuniform magnetic field with a sole component in the direction of the flow has a destabilizing effect as soon as a critical magnetic field is reached. (auth) (USGRDR)

34444 (AD-684544) MATHEMATICAL FORMALISM FOR PLASMA EQUILIBRIA IN ARBITRARY GEOMETRIES. Kuhn, Siegbert (Innsbruck Univ. (Austria). Institut fuer Theoretische Physik). Feb. 10, 1969. Contract F61052-67-C-00014. 20p. (UNICP-SR-61; AFOSR-69-738-TR). CFSTI.

The current situation in microinstability research is reviewed. Plasma equilibria starting from the Vlasov equation is next discussed. In the course of extending a method devised by J. B. Taylor and R. J. Hastie, a mathematical formalism is presented which considerably simplifies the involved calculations required by the theory. In a first practical application, this formalism is used for calculating the zero- and first-order equilibrium distribution functions in a very concise manner. (auth) (USGRDR)

34445 (AD-684545) GENERAL ALGORITHM FOR THE INVESTIGATION OF PLASMA INSTABILITIES. Floriani, Dietmar (Innsbruck Univ. (Austria). Institut fuer Theoretische Physik). Jan. 31, 1969. Contract F61052-67-C-0014. 14p. (UNICP-SR-62; AFOSR-69-0737-TR). CFSTI.

A method is proposed which uses the expansion of all quantities into series of powers of time t. It is not difficult to give the general recurrence formulas, although dissipative effects and external forces are included simultaneously. The connection to the normal mode method and to statistics is given. This algorithm should be most powerful for the computation of the initial time behavior of a plasma system. (auth) (USGRDR)

34446 (AD-684563) PLASMA INSTABILITIES AND MHD APPLICATIONS. Summary Report No. 2. Cap, Ferdinand; Herrnegger, Franz; Unteregger, Peter; Floriana, Dietmar; Falser, Helmut (Innsbruck Univ. (Austria). Institut fuer Theoretische Physik). Jan. 15, 1969. Contract F61052-670C-0014. 85p. (UNICP-FR-68; AFOSR-69-757-TR). CFSTI.

Plasma research work of the institute during the year 1968 is summarized, and investigations of macroscopic and microscopic instabilities of static and dynamic equilibrium configurations of plasmas with zero and finite electric resistivity including heat conduction, viscous effects, effects due to variable transport coefficients and finite Larmor radius effects. It is shown that an increasing nonuniform magnetic field with a component of the magnetic field in flow direction has a destabilizing effect as soon as a critical value of the magnetic field is reached. The effect of electrical resistivity gradients on instabilities is examined for an inhomogeneous plasma slab. A general algorithm and recurrence formulas were developed to calculate the initial time behavior of a general plasma configuration. The efficiency of MHD power generators was investigated. (auth) (UGRDR)

34447 (CONF-680113-(Vol.4), pp 1077-88) INFLUENCE OF A HF MAGNETIC FIELD ON PLASMA INSTABILITIES. Ivanov, A. A.; Rudakov, L. I.; Teichmann, J. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). (In French).

It is shown that a high-frequency magnetic field in a given geometry can stabilize or at least reduce the amount of growth of plasma instabilities. The stabilization mechanism of an oscillating magnetic field, perturbation of the distribution function,

loss cone and cyclotron instabilities, drift instabilities, and the effect of a multiperiodic high-frequency field are discussed. (J.F.P.)

34448 (CONF-680113-(Vol.4), pp 1089-93) EFFECT OF A MULTIPERIODIC HF FIELD ON THE TWO-STREAM INSTABILITY IN A COLD PLASMA. Teichmann, J. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu).

A brief theoretical analysis shows the stabilizing effect of a multiperiodic hf field in the most simple case of the cold spatially homogeneous plasma. (M.O.W.)

34449 (CONF-680113-(Vol.4), pp 1105-30) POSSIBILITY OF UTILIZING UHF FIELDS FOR STABILIZING FLUTE INSTABILITIES. Glagolev, V. M.; Khromkov, I. N.; Cheverev, N. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). (In French).

The interaction of ultrahigh-frequency fields ($\omega \sim 2(10)^{10}$ s^{-1}) of a cavity with a plasma ($n \simeq 10^{13}$ to 10^{14} cm^{-3}) in a static magnetic field was studied experimentally. Under this action, a paramagnetic current flows to the surface of the plasma. The growth of the static magnetic field in the interior of the plasma, which was measured, is in agreement with calculations. For $\omega_H/\omega = 0.5$, an electron paramagnetic resonance is observed leading to an abrupt increase in the plasma pressure P_0 up to $\beta_0 = 3\pi P_0/H_0^2 \simeq 0.2$. The possibilities of using this paramagnetic effect for stabilizing a plasma flute instability in various systems are discussed. (tr-auth)

34450 (CONF-680113-(Vol.4), pp 1131-46) INDIVIDUAL MOTION OF PARTICLES AND STABILIZATION OF A PLASMA IN PRESENCE OF AN OSCILLATING FIELD. Samain, A. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). (In French).

Whether a plasma mode, rendered unstable by the Landau effect, can be stabilized by the application of an oscillating electromagnetic field is examined. The fundamental frequency variation of the particle motion in the presence of an imposed field is calculated. The stabilizing effect of this is calculated, and it is proved that it is connected very simply with the variation. This conclusion generalizes previous results. Finally, the effective stabilization of a confined plasma is discussed. (J.F.P.)

34451 (CONF-680113-(Vol.4), pp 1147-72) UTILIZATION OF MHZ-BAND ELECTROMAGNETIC WAVES FOR STABILIZATION AND CONFINEMENT OF PLASMA. Levadnyi, G. B.; Orlinskii, D. V.; Osovets, S. M.; Pavlov, E. L.; Popov, L. A.; Sinitsyn, V. L. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii).

A plasma column produced by a condenser bank discharge was investigated. The stabilization circuit consisted of four or six rods placed symmetrically around the axis of the discharge chamber in which the plasma column was localized. Pictures of the plasma are given. (M.O.W.)

34452 (CONF-680113-(Vol.4), pp 1173-1201) EXPERIMENTAL STUDIES OF CONFINEMENT AND STABILITY OF PLASMA IN STRONG UHF FIELDS. Gorbunov, L. M. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). (In French).

A short account of fundamental experimental work performed recently on plasma interaction with intense uhf fields is presented. Two experiments are described in which the confinement of a plasma by uhf fields (circular guide and cylindrical cavity) was studied, in the same way as flow of plasma flux across various configurations of uhf fields was studied earlier. The results of the work described show that in the case of a denser plasma (the electronic Langmuir frequency is much weaker than the frequency of the ω_0 field), the observed phenomena can be explained using the idea of an ultrahigh-frequency mean potential. The peculiarities in plasma behavior do not appear owing to the procedure of the field production, or expressly, when the plasma density increases up to the critical level ($\omega_0 \sim \omega_{Le}$ max). (tr-auth)

34453 (CONF-680113-(Vol.4), pp 1245-62) EQUILIBRIUM OF A PLASMA COLUMN IN A ROTATING MAGNETIC FIELD. Nakach, R. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). (In French).

The self-consistent equilibrium of a plasma column in an oscillating magnetic configuration is established. The effects are described by a statistical approach in which a mean effective potential well is established that determines the distribution function of the particles as a function of the self-consistent field. (J.F.P.)

34454 (N-69-20997) CAUSES OF MAGNETIC-FIELD NONUNIFORMITY AND ITS EFFECT ON STABILITY OF THETA-PINCH PLASMA. Norwood, Joseph Jr. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). Mar. 1969. 65p. (NASA-TR-R-303). CFSTI.

Sources of the field nonuniformity are delineated and discussed. These include the collector-plate geometry, the nonlinear effect of the plasma, end effects in the coil, discontinuity in gap spacing as the current flows into the coil, and effects of the alteration in axial current distribution due to skin effect. Next, the various methods for stabilizing the plasma by eliminating field gradients are described, and a new method involving the use of a flux concentrator is proposed. The advantages of this method are compared with advantages of other techniques that have been used. Also, results of quantitative measurements of the field uniformity in an exact ½-scale model of the Langley theta pinch are presented. These results include flux concentrator and collector-plate-extension effects, as well as the effect of the volume of the collector-plate structure which excludes high-frequency flux due to skin effect. Finally, experiments which suggest that full-scale theta pinches without extensions are capable of being stabilized by flux-concentrator techniques are described. (auth) (STAR)

34455 (ORNL-4401, pp 45-51) INJECTION AND ACCUMULATION: NEUTRAL INJECTION EXPERIMENTS (DCX-1,5). Colchin, R. J.; Dunlap, J. L.; Edwards, R. S.; Massengill, L. A.; Reinhardt, R. G.; Schill, W. J.; Wells, E. R. (Oak Ridge National Lab., Tenn.).

Z-mode instabilities were studied in DCX-1.5. The results are compared with those from the PHOENIX II and ALICE experiments. (M.O.W.)

34456 (ORNL-4401, pp 52-78) INJECTION AND ACCUMULATION: MULTIPLE-PASS EXPERIMENTS (DCX-2). Clarke, J. F.; Culver, J. S.; DeCamp, S. M.; (and others) (Oak Ridge National Lab., Tenn.).

Experimental and theoretical data are given on the following topics: (1) instabilities in DCX-2, (2) microinstability-coupled drift wave, (3) effect of modified negative mass instability on the DCX-2 plasma, and (4) turbulent heating in DCX-2. (M.O.W.)

34457 (TID-25120) INVESTIGATION OF UNIVERSAL PLASMA INSTABILITIES. Annual Progress Report No. 4. Lashinsky, H. (Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). June 1, 1969. Contract AT(40-1)-3405. 18p. Dep. CFSTI.

A brief review of research during this period is given for the following: (1) wave-instability physics, (2) Q-machine technology, and (3) general experimental methods and technological spinoff possibilities. (M.O.W.)

34458 FEEDBACK STABILIZATION OF A DRIFT-TYPE INSTABILITY. Parker, R. R.; Thomassen, K. I. (Massachusetts Inst. of Tech, Cambridge). Phys. Rev. Lett., 22: 1171-3 (June 2, 1969).

Low-frequency electrostatic waves in a reflex discharge are stabilized by feeding an amplified and phase-shifted probe signal to a pair of plates at the discharge walls. The plates couple electrostatically to the $k_\parallel \approx 0$ drift-type modes and stabilize them, giving a modest increase in density. A root-locus diagram is devised to explain the observed features of the system response. (auth)

34459 SPATIAL HARMONICS OF INSTABILITIES FOR HARMONIC FREQUENCIES OF THE ELECTRON CYCLOTRON HALF-FREQUENCY. Olivain, Jack; Perceval, Francoise; Perulli, Mariano (EURATOM-CEA, Fontenay-aux-Roses, France). Compt. Rend., Ser. B, 268: 1005-8(Apr. 14, 1969). (In French).

In a system of two symmetrical electron beams confined by a uniform magnetic field, spatial harmonics of the instabilities for harmonic frequencies of the cyclotron half-frequency observed at the time of splitting of the cyclotron modes. (tr-auth)

Thermonuclear Processes

34460 (BMwF-FBK-69-13) INVESTIGATIONS ON THE MECHANICAL BEHAVIOR OF STRIP-LINES STRESSED BY SHORT-TIME CURRENTS. Steudle, W. (Technische Hochschule, Brunswick (West Germany). Institut fuer Hochspannungstechnik und Elektrische Anlagen). Apr. 1969. 24p. (In German). Dep.

Investigations were made on strip lines that can be used in electric circuits for plasma physical experiments. The proper design of the securing for the conductors requires knowledge of the forces caused by short-time currents. The mechanical stressing of the securing is calculated as a function of several parameters and is also proved experimentally in some cases. It is shown that this stress by suitable design of the securing can be kept as low as a few percent of the value which would be caused by a direct current of a magnitude equal to the maximum amplitude of the oscillatory short-time current. (auth)

34461 (LA-4195) PULSED CRYOGENIC MAGNETIC ENERGY STORAGE. Edeskuty, F. J.; Hammel, E. F.; Laquer,

H. L.; Marshall, J.; Rogers, J. D.; Ribe, F. L. (Los Alamos Scientific Lab., N. Mex.). June 6, 1969. Contract W-7405-eng-36. 11p. Dep. CFSTI.

An experimental system with a stored inductor with specifications I = 1 MA, $L_s \approx 1$ μH and a stored energy in L_s of about 1 MJ is discussed. The proposed testing of the system is also discussed. (M.O.W.)

34462 (MATT-688) TRITIUM RECOVERY FROM FUSION REACTOR BLANKETS. Johnson, Ernest F. (Princeton Univ., N. J. Plasma Physics Lab.). May 1969. Contract AT(30-1)-1238. 15p. Dep. CFSTI.

For a fusion reactor generating 2 GW electric power, in which the principal coolant for the blanket is fused salt, the recovery and regeneration of tritium should be readily accomplished in a processing plant requiring an incremental capital investment less than $3,000,000. The total inventory of tritium throughout the entire system of the blanket and the tritium recovery plant would be well under 1 kg. This low inventory and the low capital investment would obtain whether the blanket salt consisted of fluorides, nitrites, or nitrates. (auth)

34463 (MATT-693) STABILITY OF RIGID CURRENT LOOPS IN AN AXISYMMETRIC FIELD. Tenney, F. H. (Princeton Univ., N. J. Plasma Physics Lab.). June 1969. Contract AT(30-1)-1238. 40p. Dep. CFSTI.

The equations of motion for a superconducting levitated ring in an axisymmetric magnetic field are developed. Stability criteria are presented and discussed. Stable equilibria for the ring in certain static magnetic field configurations are demonstrated. (auth)

34464 (ORNL-4401, pp 176-81) ENERGETIC-PARTICLE INJECTORS FOR PLASMA PHYSICS EXPERIMENTS. Davis, R. C.; Hall, R. R.; Kelley, G. G.; Morgan, O. B. Jr. (Oak Ridge National Lab., Tenn.).

The following topics are discussed: (1) space-charge neutralization, (2) ion source filaments, (3) solar wind experiment, and (4) hydrogen clusters. (M.O.W.)

34465 (ORNL-4401, pp 182-202) MAGNETICS AND SUPERCONDUCTIVITY. (Oak Ridge National Lab., Tenn.).

The following topics are described: (1) review of ORNL superconductivity research, (2) steady-state stability of composite superconductors, (3) winding techniques for superconducting magnets, (4) liquid helium level detector, and (5) progress on the IMP facility. (M.O.W.)

34466 (ORNL-4401, pp 203-12) FUSION FEASIBILITY. (Oak Ridge National Lab., Tenn.).

Plasma considerations for feasible controlled fusion are discussed. The following are also discussed: (1) neutronics calculations and cost estimates for blanket assemblies, (2) diffusion process for removing tritium from blankets, and (3) the sputtering of Nb at 1000°C by 20-keV D^+. (M.O.W.)

34467 (UCRL-Trans-10347) REPORT ON THE WORK OF THE OPEN-CONFIGURATION COMMITTEE. Translated by Benjamin Thayne for Univ. of California Lawrence Radiation Lab., Livermore, from report DPh-PFC/Note-1025. 21p. Dep. CFSTI.

The areas considered by the committee are: (1) injection of fast particles, (2) plasma injection, and (3) turbulent heating experiments. Each present experiment is briefly discussed. (M.O.W.)

34468 PRINCIPLES AND RESULTS OF CONTROLLED NUCLEAR FUSION. Fuenfer, Ewald (Max-Planck-Gesellschaft, Munich). Umsch. Wiss. Tech., 69: 202-6(Mar. 27, 1969). (In German).

The possibilities of controlled nuclear fusion are considered along with the problems that must be solved. Methods that can be expected to be used for a controlled thermonuclear reaction are described. Topics covered include: plasma confinement by magnetic fields, equilibrium and stability, and results of some experiments with stellarators and theta-pinches. (M.C.G.)

34469 ASYMMETRIC MINIMUM-$\overline{B}$ CONFIGURATION WITH RESONANT WINDINGS OF EXTERNAL CONDUCTORS. Suzuki, Yasuo (Nagoya Univ., Japan). J. Phys. Soc. Jap., 26: 1502-7 (June 1969).

A magnetic deep-well configuration composed of a toroidal field resonantly coupled to helical and multipole fields is considered. Analytical and numerical methods are used, considering well depth, rotational transform angle, and mirror ratio. (auth)

Wave Phenomena

34470 (AD-679537) INVESTIGATION OF THE CYLINDRICAL WAVES IN RAREFIED PLASMA. Berezin, Yu. A.; Kurtmullaev, R. Kh. Translated from Zh. Prikl. Mekh. Tekh. Fiz., No. 1, 116-24(1967). 23p. (FTD-MT-24-76-68). CFSTI.

The propagation of strong cylindrical waves in cold plasma is studied theoretically and the results are compared with an experiment. The propagation of the wave is considered for regimes where dissipative effects are sufficiently strong, so that nonlinear effects arise over distances much smaller than that of the radius of plasma under study. The current sheet driving the magnetic perturbance is described as exponential or sinusoidal in time. The experimental results on the properties of the wave were obtained by means of magnetic probes at various radii in the plasma column. The comparison of the experimental results with the computer output is limited since the latter assumes a constant dissipation factor. However, the qualitative agreement is good. (auth) (USGRDR)

34471 (AD-679686) TOWARDS A THEORY OF THE NONLINEAR INTERACTION OF WAVES IN A PLASMA. Kovrizhnykh, L. M. Translated from Tr. Fiz. Inst. Akad. Nauk SSSR, 32: 173-205(1966). 59p. (FTD-MT-24-85-68). CFSTI.

A complete quantum mechanical development of phenomena of nonlinear interactions of waves in a plasma is given. After a presentation of fundamental equations of a definitive nature there follows a treatment of (1) probabilities of processes of second order; (2) probabilities of scattering processes; (3) scattering cross sections; (4) probabilities of disintegration processes; and (5) a study of certain special cases including the interaction of transverse waves and the interaction of longitudinal Langmuir waves in a plasma. (auth) (USGRDR)

34472 (AD-682315) ENERGY AND MOMENTUM OF WAVES IN NONUNIFORM PLASMAS. Buneman, O. (Stanford Univ., Calif. Inst. for Plasma Research). Dec. 1967. Contract AF-49(628)-1524. 58p. (SU-IPR-211; AFOSR-69-185-TR). CFSTI.

A plasma wave, or wave packet, possesses certain permanent attributes that can be identified as energy–momentum components, even when the unperturbed plasma is strongly nonuniform. The expressions for these attributes are quadratic in the amplitudes of the first-order field perturbations, the potential perturbations, and the distribution function perturbations, no reference to second-order perturbations having to be made. The "wave energy" is identifiable with the rf energy used in microwave and beam–plasma research. It is also identical with a certain quadratic invariant that has been employed successfully in stability studies. (auth) (USGRDR)

34473 (AD-682974) CERTAIN NONLINEAR EFFECTS IN NONCOLLIDING PLASMA AND POSSIBLE PROSPECTS OF THEIR USE. Danilkin, I. S.; Kovrizhnykh, L. M.; Raizer, M. D.; Tsytovich, V. N. Translated from Tr. Fiz. Inst., Akad. Nauk SSSR, 32: 112-29(1966). 35p. (FTD-MT-24-77-68). CFSTI.

Certain "weak" nonlinear effects in a plasma excited by electromagnetic waves are discussed. Depending on the type of excitation and the interaction of the plasma with electromagnetic radiation, the pumping of energy from longitudinal waves to transverse waves or the reverse is developed to the point that the radiation may be utilized for heating the plasma or accelerating particles of the plasma. An analysis of the use of one or more ruby lasers to produce these effects is also given. The phenomena discussed are considered to be extraordinarily promising for research in this area. (auth) (USGRDR)

34474 (CONF-680113-(Vol.3), pp 1025-36) FREQUENCY SHIFT OF A RESONANT CAVITY AND THE RF FORCE ON A PLASMA. Hagebeuk, H. J. L.; Braams, C. M. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica).

The shift of the resonance frequency of an rf cavity, in which a plasma is present, depends on the strength of a constant magnetic field, and can be zero at a critical field strength above cyclotron resonance. By a suitable choice of the rf mode and the constant magnetic field pattern the plasma can be in equilibrium with these fields. (auth)

34475 (CONF-680113-(Vol.4), pp 1203-17) INTERACTION OF ELECTROMAGNETIC WAVES WITH A PLASMA. Gorbunov, L. M. (Akademiya Nauk SSSR, Moscow. Institut Fiziki). (In French).

An account is given of previous work on the interaction of intense electromagnetic waves with a plasma. First, the treatment of small perturbations of a collisionless plasma subject to the action of an intense inhomogeneous high-frequency field is described. Then, work on the parametric amplification of waves in an inhomogeneous plasma situated in a nonuniform high-frequency electric field is discussed. Work on the self-consistent steady-state distribution of plasma in an intense uhf field and on the motion of a plasma under the action of a uhf field is described. (J.F.P.)

34476 (N-69-20774) NUMERICAL STUDY OF WEAKLY UNSTABLE ELECTRON PLASMA OSCILLATIONS. Armstrong,

Thomas P.; Montgomery, David (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Feb. 1969. 18p. (NASA-CR-100420). CFSTI.

The initial-value problem for an unstable electron plasma is solved by numerically integrating the Vlasov equation in one dimension. The situation chosen is the familiar "bump-on-the-tail" situation of quasi-linear theory. The solution is followed well beyond the point at which the electrostatic field energy has reached its maximum value. The electric field spectrum is eventually dominated by the single most linearly unstable wave number, which lies in the middle of the allowed range of wave numbers; it undergoes what appear to be the beginnings of gentle long-period oscillations characteristic of trapped-particle periodicities. It is argued that differences from quasi-linear predictions may be explained in terms of the level of initial excitations, or "noise," from which the instability is assumed to proceed. (auth) (STAR)

34477 (N-69-22179) SCATTERING OF ELECTROMAGNETIC WAVES ON HYDRODYNAMIC PULSATIONS OF A TURBULENT PLASMA. Makhan'kov, V. G.; (and others). Translated from Izv. Vyssh. Ucheb. Zaved., Radiofiz., 12: 141-3(1969). 6p. (NASA-CR-100559). CFSTI.

An abstract for the original paper appeared in NSA 23: 23202. (M.O.W.)

34478 (NP-tr-1788) DETERMINATION OF THE PARAMETERS OF A PLASMA FORMED BY THE EFFECT OF MICROWAVE POWER IN A MAGNETIC FIELD: PULSED CONDITIONS. Anisimov, A. I.; Vinogradov, N. I.; Golant, V. E.; Nanobashvili, S. I.; Pakhomov, L. P. (Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). Translation of report FTI-116. 14p. (CTO-612). Dep. CFSTI.

Microwave power was applied to a steady-state plasma formed in a magnetic field by the effect of microwave power in the 3-cm-wavelength region in electron cyclotron resonance conditions. The applied microwave pulse was of roughly the same frequency but much larger power. Its length was about 20 μsec, its power about 20 kW. The absorption of the microwave energy and the change in the plasma parameters under its influence were investigated. (auth)

34479 ATTENUATION OF A MAGNETOSONIC WAVE IN A TURBULENT PLASMA. Maksimov, G. P.; Smirnov, V. P.; Utyugov, E. G. (Inst. of Atomic Energy, Moscow). JETP Lett. (USSR) (Engl. Transl.), 9: 155-7(Mar. 5, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 9: 265-8(Mar. 5, 1969).

The effects of turbulence excited in a plasma by a straight discharge current were investigated with respect to damping of magnetosonic waves. The experimental setup is described. (M.O.W.)

34480 ANOMALOUS SCATTERING AND ABSORPTION OF LIGHT BY DECAY INTO PLASMA WAVES. Bornatici, M.; Cavaliere, A.; Engelmann, F. (EURATOM-CNEN, Frascati, Italy). Nuovo Cim., Lett., 1: 713-17(May 11, 1969).

When an intense light beam of frequency $\omega_t \gg \omega_p$ passes through a plasma, the incident energy is transferred to the particles either by direct collisional absorption (inverse bremsstrahlung), or through a cascade of lower-frequency waves due to collective (nonlinear) interactions. Only one particular small-scale collective process is discussed here, namely the nonlinear regime of the usual collective scattering of light by plasmas, i.e., the decay $t \Rightarrow t' + l$ (t = transverse, l = longitudinal electron waves), in conditions when the frequency spread of the primary light $\Delta\omega$ is less than ω_p. (M.O.W.)

34481 STATISTICAL PROPERTIES OF WAVES IN A RANDOM MEDIUM. Fibich, Moshe; Helfand, Eugene (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 183: 265-77 (July 5, 1969).

Averages of a number of properties of waves or quantum particles in random media are determined. Problems are formulated in terms of functional integrals. Techniques of the theory of Markov processes are employed to express the averaged properties in terms of the solutions of Fokker-Planck-Kolmogorov equations. Explicitly, the average density of states and Green's function of a particle in a one-dimensional (white noise) random medium are reexamined. A three-dimensional model system with a spherically symmetric, random potential $V(|\vec{r}|)$ is also considered. This model is relevant to several physical problems. Finally, statistics of the reflectivity of a slab with random, complex dielectric constant $\epsilon(x)$, are determined. A discussion is included of mathematical aspects of the type of functional integral involved in the wave-random medium problem. (auth)

34482 LARGE-AMPLITUDE ION-ACOUSTIC WAVES IN A PLASMA. Sato, Noriyoshi (Tohoku Univ., Sendai); Ikezi, Hiroyuki; Takahashi, Nobuo; Yamashita, Yoshihiko. Phys. Rev., 183: 278-87(July 5, 1969).

Experiments are performed on collisionless damping of large-amplitude ion-acoustic waves excited externally in a thermally ionized cesium plasma. The wave damping of small-amplitude ion-acoustic waves is independent of the wave amplitude, and the waves are damped by Landau damping. For large-amplitude ion-acoustic waves, the wave damping is not exponential along the plasma column. Over a few wavelengths from the wave exciter, the waves are damped almost exponentially, though the damping rate increases with the increase of the exciting voltage. After this strong damping, the wave damping begins to saturate and the damping rate becomes smaller than that of the small-amplitude waves. The results are in reasonable agreement with those of the numerical computation carried out by Armstrong on large-amplitude electron plasma waves. Amplitude oscillations are observed for $e\varphi/KT_i \gtrsim 0.4$, where $e\varphi/KT_i$ denotes fluctuating electric energy normalized with thermal energy of ions. The distance between the amplitude maxima becomes shorter by increasing the exciting voltage or frequency, and is several times longer than the wavelength. The phenomena are well interpreted by the same mechanism as predicted by the nonlinear theories of Al'tshul' and Karpman, and O'Neil on electron plasma waves. (auth)

34483 CHARACTERISTIC VARIATIONS AND WAVE PROPAGATION IN A COLLISIONLESS PLASMA. Mattei, Giulio (Univ., Pisa, Italy). Ann. Scu. Norm. Super. Pisa, Sci. Fis. Mat., 21: 745-63(1967). (In Italian).

The system of hydromagnetic equations in the Chew-Goldberger-Low theory were studied, applying precisely the characteristic variational method. The Chew-Goldberger-Low relations for a collisionless plasma are reviewed. The dynamic compatibility conditions favorable to such a system are determined for the general case. The characteristic variation equations are derived and analyzed. Two particular cases are then studied: in the first the magnetic induction vector is assumed tangent to the wave front and, in the second, this vector is assumed perpendicular to the wave front. The results relative to the propagation of plane elementary waves in the limits of the linearized equations are extended to the general propagation of wave fronts in the limits of nonlinearized equations. (J.S.R.)

34484 INVESTIGATION OF DISPERSION PROPERTIES OF PLASMA WAVEGUIDES AND PLASMA RESONATORS. Zagorodnov, O. G.; Kivshik, A. F.; Prishchepov, V. P. (Inst. of Physics and Technology, Kharkov). Ukr. Fiz. Zh., 14: 641-6(Apr. 1969). (In Russian).

A region of existence of slow electromagnetic waves was observed for the bound plasma — a cylindrical rod with density of $N_p \sim 10^{11}$ cm^{-3} obtained with a gas discharge and placed in the longitudinal magnetic field of 0 to 2000 Oe. Their phase velocities varied from 0.02 to 0.9 c (where c is the velocity of light) in the regions of normal and anomalous dispersion. Measurements of distribution of fields E_r in the plasma resonators at various pressures of residual gas in the discharge tube were performed. (auth)

34485 ELECTROSONIC WAVES IN A PLASMA WITH NEGATIVE DIELECTRIC CONSTANT. Karpman, V. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-wave Propagation, Moscow). JETP Lett. (USSR) (Engl. Transl.), 9: 291-3(Apr. 20, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 9: 480-3(Apr. 20, 1969).

The nonlinear mechanism of penetration of a transverse electromagnetic field in a plasma with negative dielectric constant is described theoretically. (M.O.W.)

34486 NONLINEAR SCATTERING OF ION-ACOUSTIC OSCILLATIONS BY ELECTRONS. Sizonenko, V. L.; Stepanov, K. N. (Physical Technical Inst., Moscow). JETP Lett. (USSR) (Engl. Transl.), 9: 282-5(Apr. 20, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 9: 468-72(Apr. 20, 1969).

It is shown that the scattering of ion-acoustic oscillation by the electrons is much stronger than by the ions. The turbulence level of the ion-acoustic pulses and the turbulent friction force acting on the electrons and ions is estimated. (M.O.W.)

34487 ANOMALOUS ABSORPTION OF A POWERFUL ELECTROMAGNETIC WAVE IN A COLLISIONLESS PLASMA. Gekker, I. R.; Sizukhin, O. V. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.), 9: 243-6(Apr. 5, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 9: 408-12(Apr. 5, 1969).

An investigation was made of the interaction between a powerful H_{11} wave with a plasma "piston" occupying the entire cross section of the waveguide. Reflection coefficient measurements are described. (M.O.W.)

34488 RADIATION PRESSURE ON AN OBJECT WITH VARYING POLARIZABILITY CHANGES. DEFORMATION ABSORPTION OF A WAVE BY VARIABLE INHOMOGENEITIES. Askar'yan, G. A. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.), 9: 241-3(Apr. 5, 1969).

Translated from Zh. Eksp. Teor. Fiz. Pis'ma Redaktsiyu, 9: 404-7(Apr. 5, 1969).

The absorption of radiation and the radiation pressure—force of a wave incident on an object whose polarizability changes as a result of changes in its volume, shape, orientation, or properties were investigated. (M.O.W.)

Shielding

Refer also to abstracts 34258, 34259, 34263, 34264, 33366, 34615, and 34701.

34489 (RT/FI-(69)17) MONOENERGETIC NEUTRON TRANSPORT THEORY FOR MULTILAYER SYSTEMS AND ASSOCIATED SHIELDING PROBLEMS. Boffi, V. C.; Premuda, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1969. 39p. Dep.

The exact treatment of the heterogeneity effects on the space–angle flux distributions of monoenergetic neutrons in symmetric as well as asymmetric one-dimensional multilayer systems is carried out in the framework of neutron transport theory. The associated shielding and penetration problems are also considered. (auth)

34490 AL'BEDO GAMMA-IZLUCHENIYA. (Albedo Gamma Radiation). Bulatov, B. P.; Efimenko, B. A.; Zolotukhin, V. G.; Klimanov, V. A.; Mashkovich, V. P. Moscow, Atomizdat, 1968. 424p.

A brief review and analysis is given of the published data and results of the experimental work on the inverse γ-ray scattering. Monte Carlo and computer measurements used for studying the differential characteristics of the albedo of a thin beam from a γ source at energies from 60 keV to 10 MeV in water, aluminum, iron, and lead scatters are discussed, as well as integral albedo characteristics. (R.V.J.)

Solid-State Physics

Refer also to abstract 33965.

34491 (KURRI-TR-22) REPORT OF COOPERATIVE RESEARCH EFFORTS AT THE KYOTO UNIVERSITY REACTOR INSTITUTE DURING FIRST HALF OF 1965. Iwata, Shiro (Kyoto Univ. (Japan). Research Reactor Inst.). [1965]. 136p. (In Japanese). Dep.

Summaries of cooperative research efforts conducted at the Kyoto Reactor Institute between the Institute and various cooperating institutions are presented. The subjects are: studies of radioactive nuclei by (n,γ) reactions; study of defects in ZnS crystals; neutron damage to single crystals of the ferroelectric Rochelle salt; studies on KH_2PO_4 ferroelectric by neutron diffraction; neutron irradiation of nucleic acid bases; electron spin resonance of DNA and its structural components (basic groups); structure and properties of rare earth–transition metal alloys; studies on the structure of ^{131}Xe; damage to ionic crystals by neutron irradiation; neutron diffraction experiments with $CaFe_2O_4$; neutron diffraction; neutron diffraction by MnN_4, decay of ^{117}Ca + ^{117m}(3 hr); studies in changes to materials by neutron irradiation; magnetic properties of transition metals; irradiation effects to organic semiconductors; studies on the application of activation analysis to sanitary engineering; activation studies of traces of nonmetallic substances in steel; effect of neutron irradiation on the plasticity of pure iron; radiochemical analysis for thorium in the waters of Japan; studies on the chemical effects accompanying β decay of rare earths in rare earth chelates (^{177}YbCyDTA and ^{171}ErCyDTA systems); studies of transuranium element complexes; studies on rapid activation analysis procedures; analysis for U, Th in rocks and minerals by the (n,γ) reaction; synthesis of F-18 labeled compounds; LET effects in radiation induced polymerizations; separation and analysis of transition elements (Tc, Ru); application of the solvent extraction of metal chelates and basic dyes to RI separations; studies on the chemical behavior and separation of radioactive rhenium; studies on the separation and analysis of isotopes by activation and plasma formation; studies on the neutron irradiation of polymers (mainly dielectrics); hot atom chemistry of hypophosphoric acid; formation of directly tagged organometallic chelates at a reactor core; separation of rare earth elements by precipitation chromatography; studies on polyphosphoric acids by activation analysis; trace analysis in standard silicate by neutron activation; ESR of condensed phosphates; studies on nuclear cross sections for neutrons and production of RI; coprecipitation of Tc, Re, Mo, and W on iron (II) and (III) hydroxides; studies of protein dissociation in water using RI; activation analysis for rare earths in sea water; studies of electrode reactions under irradiation; effect of neutron irradiation of Euglena cell ribosomal particle; tritiation of nucleic acids and their structural components by the recoil method; mechanism of radiation damage recovery of T1 phage; effect of neutron irradiation of flower pollen and spores; activation analysis for K, Na, Ca, and Mg in large cells. (TTT)

34492 (KURRI-TR-25) REPORT OF COOPERATIVE RESEARCH EFFORTS AT THE KYOTO UNIVERSITY REACTOR INSTITUTE DURING LATTER HALF OF 1965. Iwata, Shiro (Kyoto Univ. (Japan). Research Reactor Inst.). [1966]. 141p. (In Japanese). Dep.

The reports of the second half of 1965 of cooperative research conducted at the KURRI are summarized. The subjects are: neutron diffraction of metal compounds; activation analysis of rare earth elements; neutron diffraction studies on $CeFe_2O_4$; studies on the effect of radiation on electron active components; studies on the permeability of animal ova; studies on the chemical behavior and separation of radioactive rhenium; morphological studies on microcell structure by activation analysis; nuclear structure of ^{131}I and ^{131}Xe; nuclear structure study of ^{191}Pt by e-γ and γ-γ angular correlation; neutron irradiation of nucleic acid derivatives; tritiation of nucleic acids and its components by the recoil method; irradiation study of capsule material; studies on damage to uranium carbide; determination of the crystal structure of actinide compounds by neutron diffraction; precise dose rate measurements of low-energy radiation about reactors; space distribution of the neutron flux in a reactor and measurements of energy distributions with a neutron spectrometer using semiconductor detector; studies on polyphosphoric acids by activation analysis; determination of trace elements in standard silicic acid by neutron activation analysis; determination of Th in the waters of Japan by activation analysis; damage to nucleic acids by neutron irradiation; analysis for U, Th in rocks and minerals by the (n,γ) reaction; ESR of DNA and its constitutive components (basic groups); studies on atmospheric turbulent flow with a supersonic wind velocity gage; optical and magnetic absorption studies of defects in alkali halide crystals containing some silver and cadmium chloride crystals as a result of neutron and γ irradiation; study of type A linear hormones in blood by radiochemical analysis; activation analysis for free siloxine in blood; activation analysis for elements in biological tissue; studies on ternary fission; measurement of fast neutron spectra and space distribution in matter and after passage through matter; LET effects in radiation induced polymerization; studies on the application of activation analysis to sanitary engineering; altering the properties of bentonite by neutron irradiation; activation analysis for rare earths in sea water; studies on complex salts of transuranium elements; atmospheric diffusion about the KUR; determination of the crystal structure of actinide compounds by neutron diffraction; radiation effects on semiconductors; separation and analysis of isotopes from activation; studies on electrode reactions under irradiation; magnetic properties of transition metals; studies on the properties of neutron resonance levels; studies of the Mössbauer effect on metals suffering radiation damage; starting control of a nuclear reactor; radiation effects on organic semiconductors; studies on the changes in matter as a result of neutron irradiation; direct tagging of organic compounds with ^{14}C by hot atomic chemistry; neutron diffraction; tritium recoil reactions with organic compounds containing unsaturated bonds; studies on the chemical effects accompanying β decay of rare earths in rare earth chelates (^{147}NdDTPA and ^{149}NdDTPA systems); activation analysis of biological materials; activation analysis of purple quartz, smoky quartz, manganese glass, natural pearl and natural pearl seed; separation and analysis of transition metal elements (Tc, Ru); studies on rapid activation analysis; decay of ^{117}Cd + ^{117m}(3 hr); LET effects on the radiolysis of aqueous potassium ferricyanide solution; neutron radiation damage to ionic crystals; studies on muscle diseases (on the Mn metabolism in patients with nervous disorders); neutron irradiation of antiferromagnetic

bodies; studies on radioactive decontamination using step towers; hot atom chemistry of hypophosphoric acid salts; neutron damage to high-purity metals; activation analysis for rare earths in waters of hot springs; formation of directly tagged metal chelate compounds in a reactor; separation of rare earths by soluble paper chromatography utilizing oxine precipitation; recoil chemistry and activation analysis of organic compounds and complexes; neutron irradiation of PN junctions in lead sulfide; studies on radioactive decontamination using step towers; and activation analysis for divalent ion trace impurities in alkali halide single crystals. (TTT)

Radiation Effects

34493 NEW METHOD FOR DETERMINING ACTIVATION ENERGIES APPLIED TO SUBSTAGE-III ANNEALING OF Au-ION IRRADIATED Au FILMS. Krimmel, E. F. (Univ., Tuebingen, Ger.). Phys. Status Solidi, 33: K63-5(May 1, 1969).

Au films were vacuum-deposited and irradiated with fast Au ions from an ion gun. Annealing of the resulting irradiation damage was measured through the electric resistivity. The inflection point of an annealing stage shifts to higher temperature with thickness; this effect can be explained as being due to defects migrating from the film interior to the surface. For 2 films of different thicknesses d_1 and d_2, $d_1^2/d_2^2 = \exp[-E/k(1/T_1 - 1/T_2)]$. Au films of thicknesses between 150 and 500 Å irradiated with 10^{16} ions/cm^2 at 40 keV shows several substages of stage III near room temperature. The activation energies determined by the above equation are presented. (D.L.C.)

34494 OPTICAL REFLECTIVITY OF IRRADIATED SEMICONDUCTING COMPOUNDS. Kahan, A. (Air Force Cambridge Research Labs., Bedford, Mass.); Bouthillette, L.; Spitzer, W. G. J. Appl. Phys., 40: 2678-80(May 1969).

The variation in the ir-reflectivity, as a function of free-carrier concentration and scattering relaxation time, is applied as the measure of carrier removal and mobility change. This method, applicable to most III–V and II–IV semiconducting compounds, reflects the concentration of the free carriers, in the wavelength range near and above the plasma reflectivity minimum, to the depth of optical beam penetration only. The unique advantage of this measurement technique is that it affords an independent determination of the number of carriers and relaxation time on each surface, rather than average sample properties. The specific results given here for 1-MeV-electron-irradiated silicon-doped GaAs illustrate the feasibility of this routine, nondestructive technique as a powerful tool for study of compound semiconductor radiation damage. (TSS)

34495 RECOMBINATION LIFETIMES IN HIGH-PURITY SILICON AT LOW TEMPERATURES. Leadon, R.; Naber, J. A. (Gulf General Atomic Inc., San Diego, Calif.). J. Appl. Phys., 40: 2633-8(May 1969).

Transient recombination lifetimes were measured in high-purity, n-type, float-zone silicon from 4.2°K to room temperature. Photoconductivity decay curves and quiescent electrical conductivity values were obtained by a microwave reflection technique which does not require electrical contacts to the sample. Experiments were performed at low injection levels on unirradiated samples and after irradiation with 30-MeV electrons. An unusual feature of the data is a pronounced increase in lifetime with decreasing temperature below 45°K, similar to a trapping effect. This variation of lifetime with temperature is explained, using the two-lifetime transient analyses of Sandiford and Wertheim. The temperature dependences of the capture cross sections are calculated and compared with the theoretical predictions of Lax and with other experimental results. (auth)

34496 STUDIES OF ELECTRON BOMBARDMENT DAMAGE IN GaAs BY THERMALLY STIMULATED CONDUCTIVITY MEASUREMENTS. Schade, H. (Radio Corp. of America, Princeton, N. J.). J. Appl. Phys., 40: 2613-16(May 1969).

Semi-insulating, melt-grown n-type GaAs was irradiated with 1-MeV electrons of densities of 10^{16} to 10^{17} electrons/cm^2, thereby introducing 10^{17} to 10^{18} cm^{-3} defects. The irradiation decreased the dark conductivity and the photosensitivity by about an order of magnitude, indicating that additional acceptor-like recombination centers were generated. However, no additional trapping centers were detected by thermally stimulated conductivity measurements for energies in the range 0.15 to 0.7 eV from either band edge. This suggests that the centers introduced had larger ionization energies than any other main trap present, namely, >0.5 eV. This is consistent with the effects of electron bombardment on luminescence in GaAs. Moreover, the calculated concentrations of the traps previously present were decreased, especially after the introduction of as many as 10^{18} cm^{-3} defects. This apparent decrease at these very high defect densities can be explained by assuming that the carriers tend to recombine via an intercenter process, rather than entering the bands. Annealing was found to remove most, but not all, of the effects of electron bombardment. (auth)

34497 RAPID ANNEALING IN n-TYPE SILICON FOLLOWING PULSED 10-MeV ELECTRON IRRADIATION. Arimura, I.; Freeman, R. R. (Boeing Co., Seattle, Wash.). J. Appl. Phys., 40: 2570-7(May 1969).

The forward voltage V_f across a p^+–n silicon diode, biased at constant current, was used to monitor the rapid annealing of damage introduced by a 5-μsec pulse of 10-MeV electrons. Silicon diodes (1N648) were irradiated at various temperatures from 90° to over 350°K. The large increase in V_f observed immediately after the irradiation pulse recovered partially to its preirradiation value in times varying from a few milliseconds at 300°K to a few hundred milliseconds at 100°K. The ratio of the change in V_f at 100 μsec after the irradiation pulse to the change after recovery had been completed varied from approximately three at 300°K to nearly seven at 100°K. The large degree of recovery indicates that defect annihilation is most likely responsible for the recovery process. The recovery kinetics of the rapid annealing are closely described by Waite's theory of diffusion-controlled annealing involving recombination of correlated and uncorrelated defects. Particularly for temperatures above 170°K, the initial stage of recovery proceeds at a rate proportional to $(t)^{\frac{1}{2}}$ for nearly 50% of the annealing, as the theory predicts. The temperature dependence of the diffusion constant for this initial recovery is governed by an activation energy of approximately 0.12 eV. Comparison with other results indicates the possibility that diffusion of an interstitial into a divacancy, whereupon annihilation occurs, is responsible for the recovery mechanism. The low activation energy obtained is the result of the large injection of holes used in the measurements, that the injection level alters the charge state of the interstitial and recovery is enhanced. (auth)

34498 ELLIPSOMETRIC ANALYSIS OF RADIATION DAMAGE IN DIELECTRICS. Schroeder, J. B.; Dieselman, H. D. (Perkin-Elmer Corp., Norwalk, Conn.). J. Appl. Phys., 40: 2559-64 (May 1969).

The reflectivities have been calculated by the matrix method using a digital computer for light polarized parallel (P) and perpendicular (S) to the plane of incidence for dielectric materials with continuously varying index of refraction profiles. Assuming various index of refraction profiles up to the computed penetration depth for positive ions, it was found that the phase difference between the P and S waves is sensitive to the magnitude and shape of the index perturbation. Results for 150 keV Ar^+ bombardments of transparent vitreous silica are presented which show that implanted argon increases the refractive index of the solid by 0.02. The implanted ions appear to out diffuse between 200 and 600°C. (auth)

34499 ENERGY DEPENDENCE OF KRYPTON ION DAMAGE IN GOLD. Hoegberg, G.; Norden, H. (Chalmers Univ. of Tech., Goteborg). Phys. Status Solidi, 33: K71-3 (May 1, 1969).

An experiment was conducted to determine the energy dependence directly from the number of spots formed per incoming ion. Single-crystal Au films were prepared and annealed, and then irradiated along the common ⟨111⟩ foil axis at a flux of 10^{10} ions/cm^2. Electron microscopic examination yielded a spot density vs ion energy graph; after a rapid rise at ~8 keV, the density for Kr remains nearly constant at ~0.6 spots/ion. Preliminary irradiations with Ar and Xe show similar results (0.3 spots/ion for Ar and 1.0 spots/ion for Xe). It is suggested that the clusters were formed in primary collision cascades, although agglomeration occurs at lower energies. (D.L.C.)

Physical Properties

34500 SOME PROPERTIES OF FERROMAGNETIC AND TRANSITION METAL FILMS PREPARED BY EVAPORATION ONTO LIQUID HELIUM COOLED SUBSTRATES. Bosnell, J. R. (Royal Radar Establishment, Great Malvern, Eng.). Thin Solid Films, 3: 233-49(Apr. 1969).

Results are presented on the properties of thin films of Y, Sc, Fe, Ni, and Ni–Fe alloys produced by deposition onto liquid-helium-cooled substrates. An attempt was made to correlate the resistivity, structure, and magnetic properties of the films. In particular, nickel films so produced were found to be nonferromagnetic at room temperature, possibly because of the occurrence of superparamagnetism in these very small crystallite size films. (auth)

34501 REVIEW OF THE ELECTRONIC AND MAGNETIC PROPERTIES OF COMPOUNDS OF THE LANTHANIDES WITH

THE ANIONS OF THE 5th GROUP OF THE PERIODIC TABLE. Junod, P.; Menth, A.; Vogt, O. (Ecole Polytechnique Federale, Zurich). Phys. Kondens. Mater., 8: 323-70(1969). (In French).

The most important publications are reviewed, as well as many unpublished measurements by the authors. The influence of the cubic crystal field on the magnetic properties of binary compounds containing the trivalent ions Pr^{3+}, Sm^{3+}, Tm^{3+} and Yb^{3+} is studied. Crystal field- and exchange parameters (molecular field approximation) were determined for the ferromagnetic nitrides GdN, TbN, DyN, HoN and ErN. The mechanism of the electrical conductivity is still unknown. (auth)

34502 ELECTRONIC PROPERTIES OF TWO NEW ELEMENTAL FERROMAGNETS: fcc Pr AND Nd. Bucher, E.; Chu, C. W.; Maita, J. P.; Andres, K.; Cooper, A. S.; Buehler, E.; Nassau, K. (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. Lett., 22: 1260-3(June 9, 1969).

The fcc phases of Pr and Nd have been stabilized at room temperature and at liquid-helium temperatures and both prove to be ferromagnetic. The measured electronic properties of this new phase are discussed in the light of presently accepted phase diagrams. The existence of the fcc phase accounts for a variety of anomalous data reported for double-hcp Pr. (auth)

34503 MAGNETIC SUSCEPTIBILITY STUDIES OF THE CUBIC LAVES PHASES $Sc(Ni_{1-x}Co_x)_2$. Collings, E. W. (Battelle Memorial Inst., Columbus, Ohio); Smith, R. D.; Lecander, R. G. J. Less-Common Metals, 18: 251-66(July 1969).

Magnetic susceptibility studies were made on the cubic C15($MgCu_2$-type) Laves phases $Sc(Ni_{1-x}Co_x)_2$; the temperature dependences of susceptibility of the compounds $ScNi_2$ and $ScCo_2$ have been measured in the range 78 to 600°K. The magnetic susceptibility of $ScNi_2$ at room temperature is 1.4 μemu/g and decreases by about 20% between 78°K and room temperature. Although the room temperature susceptibility of $ScCo_2$ (12.6 μemu/g) is an order of magnitude larger than that of $ScNi_2$, the form of the temperature dependence indicates that the cobalt does not carry a local magnetic moment. Experiments indicate that $ScNi_2$ and $ScCO_2$ may undergo severe surface damage by crushing at room temperature, sufficiently to yield metallic nickel or cobalt, respectively. The compounds are also extremely prone to oxidation above about 500°K. Even at low pressures, atmospheric oxygen reacts with the scandium to leave free metallic nickel or cobalt, respectively. For comparison, the magnetic and structural properties of the cubic Laves phases RNi_2 and RCo_2 [where R represents Sc, Y, Ln (lanthanides), Ti and Zr] are reviewed. (auth)

34504 ELECTRON MEAN FREE PATHS IN METALS. Proceedings of an International Conference Held at Zurich, Switzerland, 3–5 September 1968. Chambers, R. G.; Olsen, J. L.; Ziman, J. M. (eds.). Phys. Kondens. Mater., 9: 1-210(1969). (CONF-680958).

Of the 31 papers presented at this meeting, 23 full papers are included here, along with abstracts and discussions of the remaining eight. Only four of the papers are in scope for NSA, and separate abstracts are included for each. (L.M.T.)

For abstracts of individual papers see: 34505–34508.

34505 OBSERVATIONS OF A QUADRATIC TEMPERATURE DEPENDENCE IN THE LOW TEMPERATURE RESISTIVITY OF SIMPLE METALS. Garland, James C.; Bowers, R. (Cornell Univ., Ithaca, N. Y.). Contract AT(30-1)-2150. Phys. Kondens. Mater., 9: 36-44(1969).

From Conference on Electron Mean Free Paths in Metals, Zurich, Switzerland. See CONF-680958.

Precise measurements of the low-temperature resistivity of aluminum, indium, potassium, and sodium were measured, and evidence of a T^2 temperature dependence in the resistivity of aluminum and indium was obtained. (auth)

34506 THE REVERSAL OF HALL FIELDS IN ALUMINIUM AND INDIUM. Ashcroft, N. W. (Cornell Univ., Ithaca, N. Y.). Phys. Kondens. Mater., 9: 45-53(1969).

From Conference on Electron Mean Free Paths in Metals, Zurich, Switzerland. See CONF-680958.

Fields at which the Hall resistivity vanishes in Al and In are shown to yield information on band relaxation times and their temperature dependences. (auth)

34507 INFLUENCE OF SCATTERING ON THE ANISOTROPY OF RELAXATION TIME IN INDIUM ALLOYS. van der Mark, W. (Eidgenoessische Technische Hochschule, Zurich); Ott, H. R.; Sargent, D.; Rasmussen, F. B. Phys. Kondens. Mater., 9: 63-7 (1969).

From Conference on Electron Mean Free Paths in Metals, Zurich, Switzerland. See CONF-680958.

The low-field Hall effect in indium at low temperatures is very sensitive to the kind of scatterers introduced. In the presence of small-angle dislocation scattering, the Hall coefficient R_0 is positive, while diffuse scattering such as that caused by boundary scattering leads to a negative value for R_0. Data taken on alloys of indium with Ga, Tl, Pb, Sn, Hg, Cd and Bi are analyzed by comparing them with the dislocation and size effect and by interpreting the differential cross sections of these scatterers in terms of their effect on R_0. The behavior of R_0 of these alloys as a function of temperature is also described. (auth)

34508 SONDHEIMER OSCILLATIONS IN THE HALL RESISTIVITY OF CADMIUM. Schwarz, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phys. Kondens. Mater., 9: 164-9(1969).

From Conference on Electron Mean Free Paths in Metals, Zurich, Switzerland. See CONF-680958.

Sondheimer oscillations in the Hall coefficient of cadmium single crystals were measured in dependence on crystal orientation and sample surface quality. The results prove that the lens-shaped electron Fermi surface in the third band is responsible for these oscillations. Beside the fundamental oscillation, harmonics of the Sondheimer oscillations were observed that are due to partially specular reflection of the electrons at the sample surface. (auth)

34509 NUCLEAR MAGNETIC RESONANCE STUDY OF THE NIOBIUM–NITROGEN SYSTEM NbN_x. Bennett, Robert A. (Wayne State Univ., Detroit); Hooper, H. O.; Roy, U. J. Appl. Phys., 40: 2441-4(May 1969).

Nuclear magnetic resonance was employed to identify the phases of the system NbN_x in several samples of niobium nitride. The ϵ phase was identified by a characteristic second-order quadrupolar-broadened central transition with two sets of satellite lines also being observed. The quadrupole coupling constant was determined for the ϵ phase ($e^2qQ/h = 10.6 \pm 0.1$ MHz) and for the δ phase ($e^2qQ/h = 4.3 \pm 0.4$ MHz). The relative amounts of the phases present in a sample were also determined in two samples. (auth)

34510 LATTICE DYNAMICS BY NEUTRON SCATTERING. Boffi, S. (Univ., Pavia, Italy. Istituto Nazionale di Fisica Nucleare, Pavia, Italy); Caglioti, G. Energ. Nucl. (Milan), 16: 369-77(June 1969).

The major developments of the last few years in the field of the experimental methods of slow neutron spectrometry and their applications to lattice dynamics of metals, alloys, and dielectric materials are summarized. Recent progresses of three-axis and time-of-flight neutron spectrometry are reported. Furthermore, the theory of neutron scattering is presented in the frame of the generalized susceptibility, and is discussed both for the harmonic and the anharmonic crystal. (auth)

Moessbauer Effects and NMR

Refer also to abstracts 33397, 33553, 33563, and 33572.

34511 NUCLEAR MOMENTS AND HYPERFINE STRUCTURE ANOMALY FOR GADOLINIUM. Baker, J. M.; Copland, G. M.; Wanklyn, B. M. (Oxford Univ.). J. Phys. C (London), 2: 862-9 (May 1969).

The technique of ENDOR was used on the isotopes ^{155}Gd and ^{157}Gd in Gd^{3+} in CeO_2 single crystals in order to obtain accurate values of the nuclear magnetic moments and the hyperfine structure parameters. The values obtained were:

	^{155}Gd	^{157}Gd	$^{155}Gd/^{157}Gd$
A(kHz)	+12048(3)	+15809(5)	0.7621(5)
μ_n(nm)	−0.2567(6)	−0.3363(12)	0.7633(45)

From the numbers in the last column, called R(A) and R(g) respectively, a hyperfine structure anomaly Δ can be calculated whose accuracy is limited primarily by that of R(g). It is shown that a more accurate value of R(g) = 0.76252(17) may be derived from the atomic beam work of Unsworth(1969). This accurate value leads to a hyperfine structure anomaly $\Delta = (+0.05 \pm 0.09)\%$. From a knowledge of the fraction of the hyperfine interaction which is contributed by s electrons it can be shown that the hyperfine structure anomaly which would be exhibited by a single unpaired s electron is $\Delta_s = (+0.07 \pm 0.12)\%$. Discrepancies between these values and those indicated by other data are discussed. Discrepancies with optical determinations are shown to be probably not significant; those with determinations using nuclear magnetic resonances in magnetically ordered material are significant, but are not understood. (auth) (UK)

Theoretical Physics

34512 SPRINGER TRACTS IN MODERN PHYSICS. VOLUME 46. Hoehler, G. (ed.). Berlin, Springer-Verlag, 1968. 135p. $11.00; DM 44,--. (In English and German).

Three chapters are included on the following subjects: state of matter at very high pressures and temperatures; symmetries and current algebras for electromagnetic interactions; and radiative corrections in elementary particle physics. Separate abstracts were prepared for each chapter. (TSS)

For abstracts of individual chapters see: 34432, 34557, and 34632.

34513 SYMBOL-MANIPULATION TECHNIQUES FOR PHYSICS. Brody, T. A. Documents on Modern Physics. New York, Gordon and Breach, Science Publishers, 1968. 103p. $8.50 cloth, $4.50 paper.

The discussion of symbol manipulation techniques covers recursive functions, list structures, and functions and concepts of LISP language. Also applications in physics and related fields and the organization of processors are covered. (J.F.P.)

34514 ANHARMONIC OSCILLATOR IN FUNCTIONAL INTEGRATION AND IN PERTURBATION THEORY. Roepke, Gerd (Technische Univ., Dresden). Acta Phys. Aust., 28: 290-8 (1968).

The anharmonic oscillator $L/\hbar = (\mu/2)\,\dot{x}^2 - \varkappa x^2 - \lambda x^4$ is treated for $\lambda^2/(\mu\varkappa^3) \ll 1$ and $(\mu\varkappa^3)/\lambda^2 \ll 1$ by evaluating functional integrals in a lattice-time. A divergent perturbation expansion is transformed into a convergent one. (auth)

34515 GAUGE-INVARIANT STATISTICAL PHYSICS. Revzen, M. (Univ. of California, Los Angeles). Phys. Rev. Lett., 22: 1239-40(June 9, 1969).

The requirement of an invariant velocity of a system of bosons describable by a nonrelativistic grand-canonical potential is used to propose a gauge-invariant formulation of the grand-canonical system. (auth)

34516 RADIATION INDUCED BY CHARGED PARTICLES MOVING IN MATTER. Grigor'ev, V. I.; Muzylev, E. L. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., No. 2, 101-4(Mar.-Apr. 1969). (In Russian).

Using estimates for energy-level shifts of atoms on excitation by charged particles, the relation of this shift to momentum of the fast particle and the sign of its charge was investigated. The electron interacting with the electromagnetic field of a moving charged particle was studied. The Furry representation was used to describe the nuclear effects on the process. (tr-auth)

34517 AN APPROXIMATE SOLUTION OF THE BOUNDARY PROBLEM FOR THE EQUATIONS OF A STATIONARY, ELECTROSTATIC CHARGED-PARTICLE BEAM. Danilov, V. N.; Syrovoi, V. A. Zh. Prikl. Mekh. Tekh. Fiz., No. 1, 11-19(Jan.-Feb. 1969). (In Russian).

The equations referring to a spatial, stationary, electrostatic beam of charged particles of the same sign which fill the space between two adjoining curved surfaces, were examined. It was assumed for the study that the flow was nonrelativistic and nonturbulent. The solution was based on an asymptotic series, the parameters of which reflected the ratio of the longitudinal and transversal characteristics of the system. The conditions investigated included limitation of the emission by space charge (p condition), temperature (T condition), and nonzero initial velocity (U condition). The asymptotic representation was derived from formulas for the corresponding one-dimensional flow between parallel planes. The boundary problem for emission under p condition involves the determination of the current density under a given electrode geometry and given accelerating tension. The results obtained were compared with the exact solution for flow in a plane emitter with curved trajectories, using as an example the low between two adjoining cylindrical electrodes under breakdown of the coaxial character. (TTT)

34518 LECTURES ON QUANTUM MECHANICS. Baym, Gordon. Lecture Notes and Supplements in Physics. New York, W. A. Benjamin, Inc., 1969. 604p.

The basic principles of quantum mechanics are first discussed in terms of simple systems of photon and neutral K-meson polarization. The quantum mechanical description of particles and radiation is then developed in detail. Recent applications such as Cooper pairs, the Aharonov-Bohm effect, Regge poles, and the Hanbury-Brown Twiss experiments are included. (L.B.S.)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 34552 and 34553.

Electromagnetic

Refer also to abstract 33399.

34519 (INR-1009) RELATION OF THE MUON NUMBER ON THE SIZE OF THE E.A.S. Gawin, J.; Hibner, J. (Institute of Nuclear Research, Warsaw (Poland)). 1968. 12p. Dep.

According to the model of EAS developement assumed in the behavior of the α-exponent in the commonly accepted relation $\overline{N}_\mu \sim \overline{N}_e^{\alpha}$ depends strongly on the mass composition of the primary cosmic radiation at very high energies: it is constant for the unmodulated composition but changes its value distinctly for the modulated composition. The analysis of the experimental data of the Lodz, Moscow and Haverah Park groups shows a certain variation of α, but it is too early to assert that this variation agrees satisfactorily with the calculated one. With more exact results and more adequate representation of the experimental data, it will be possible to confirm (or deny) the adumbrated trend in favor of the assumption of the modulated composition. (auth)

34520 LATERAL DISTRIBUTION OF THE MUON COMPONENT IN THE CENTRAL REGION OF EXTENSIVE AIR SHOWERS. Bonczak, B. (Univ., Lodz, Poland); Firkowski, R.; Gawin, J.; Hibner, J.; Maze, R.; Wdowczyk, J.; Zawadzki, A. J. Phys., A (London), 2: 334-40(May 1969).

Using a new device for extensive air shower core localization consisting of four sets of Conversi neon detectors of total area 9 m^2 (comprising 36,000 neon tubes) cores were located with high accuracy and the lateral muon distribution was measured for a threshold energy of 0.6 GeV. The 50,000 recordings of muon density by means of the Lodz muon analyzer allowed a high accuracy for the mean density to be obtained. The measurements were performed in the central part of extensive air showers (2 to 30 m from core). The interpretation of the shape of the distribution is discussed and compared with theoretical calculations. As the muon lateral distribution is mainly determined by the angles of emission of parent pions, some features of the distribution of transverse momenta p_t of pions produced in air can be analyzed. For low p_t values a discrepancy is found with the Cocconi empirical p_t distribution from accelerator data. A flattening of the muons' lateral distribution near the shower axis is interpreted as being due to a lack of small p_t values. (auth)

34521 COHERENT PHOTOPRODUCTION OF THE η^0 MESON FROM DEUTERIUM. Anderson, R. L. (Stanford Linear Accelerator Center, Calif.); Prepost, R. Contracts Nonr 225(67); AT(11-1)-881. Phys. Rev. Lett., 23: 46-50(July 7, 1969). (COO-881-234).

The isoscalar part of the η^0 photoproduction amplitude near threshold was determined by differential cross section measurements of the coherent process $\gamma + d \rightarrow \eta^0 + d$ from near threshold to 150 MeV above threshold. By comparison of the results with earlier measurements of $\gamma + p \rightarrow \eta^0 + p$ and a recent measurement of $\gamma + d \rightarrow \eta^0 + (p,n)$ it is possible to argue that the isovector part of the η^0 photoproduction amplitude near threshold is much smaller than the isoscalar part and is consistent with zero. (auth)

34522 AN UPPER LIMIT FOR THE BRANCHING RATIO $\Gamma(\phi \rightarrow \pi^0 + \gamma\gamma)/\Gamma(\phi \rightarrow \text{all})$. Bemporad, C. (Univ., Pisa, Italy. Istituto Nazionale di Fisica Nucleare, Pisa, Italy); Braccini, P. L.; Castaldi, R.; Foa, L.; Luebelsmeyer, L.; Schmitz, D. Phys. Lett., 29B: 383-6(June 9, 1969).

A report is given on an experiment performed at DESY to search for the $\pi^0 + \gamma$ decay of the ϕ mesons, photoproduced at 5.5 GeV on a Zn target. From the known production cross section and the calculated detection efficiency, an upper limit for the branching ratio $B = \Gamma(\phi \rightarrow \pi^0 + \gamma\gamma)/\Gamma(\phi \rightarrow \text{all})$ of 0.35% was obtained. (auth)

Weak

Refer also to abstracts 33471, 33485, 33504, and 33505.

34523 (SRO-474-1) FEASIBILITY STUDY OF ANTINEUTRINO ABSORPTION CROSS SECTION MEASUREMENTS. Annual Report, May 1968-May 1969. Avignone III, F. T.; Darden III, C. W. (South Carolina Univ., Columbia. Dept. of Physics). Apr. 1969. Contract AT(38-1)-474. 19p. Dep. CFSTI.

The neutron and gamma ray background was measured at several locations near one of the Savannah River production reactors. A site was chosen at which the calculated antineutrino flux from the reactor is high enough to conduct inverse beta decay experiments while neutron and γ-ray backgrounds are relatively low. Studies of the γ-ray singles and coincidence γ-ray backgrounds inside of various configurations of lead, boron loaded polyethylene and cadmium shielding were made. An optimum shielding configuration was determined. CsI(Na) scintillators were investigated as possible detectors in low background γ-ray coincidence measurements and found to be inferior to NaI(Tl) scintillators for this type of experiment. The effectiveness of a NaI(Tl) live anticoincidence shield in reducing the background coincidence events was investigated. An event consists of a coincidence resulting from the deposit of approximately 0.511 MeV, in each of two NaI(Tl) detectors placed inside. The shield was found to reduce the coincidence background by only about 31%. Apparatus for observing the reaction $p(\bar{\nu}\beta^+)n$, without observing the capture of the free neutron, was designed and built. Preliminary results indicate that at present approximately 10% of the total count should be actual antineutrino capture events. On the grounds of these preliminary results, it is concluded that a measurement of the cross section for the reaction $p(\bar{\nu}\beta^+)n$ and the fission antineutrino spectrum, without observing the capture of the free neutron, is feasible. (auth)

34524 MEASUREMENT OF THE BRANCHING RATIO $K_L^0 \rightarrow 2\pi^0/K_L^0 \rightarrow 3\pi^0$. Cence, R. J. (Univ. of Hawaii, Honolulu); Jones, B. D.; Peterson, V. Z.; (and others). Phys. Rev. Lett., 22: 1210-14(June 2, 1969).

The rate of the CP-nonconserving decay $K_L^0 \rightarrow 2\pi^0$ was measured relative to that of $K_L^0 \rightarrow 3\pi^0$ using a monoenergetic K beam and a nearly 4π solid-angle detector system employing lead-plate spark chambers and shower counters. The measured branching ratio $1.31\% \pm 0.18\%$ (statistical) $\pm 25\%$ (systematic) leads to a value for the CP-nonconservation parameter $|\eta_{00}|^2$ of $(14.1 \pm 3.4) \times 10^{-6}$. (auth)

Strong (Baryon-Induced)

Refer also to abstracts 33399 and 33510.

34525 (BNL-13694) THE ANALYSIS OF 28.5 GeV/c pp INTERACTIONS PRODUCING 6 OR MORE CHARGED PARTICLES. Connolly, P. L.; Kenyon, I. R.; Kinsey, R. R.; Thorndike, A. M. (Brookhaven National Lab., Upton, N. Y.). May 21, 1969. 29p. (CONF-690608-3). Dep. CFSTI.

From International Conference on Elementary Particles, Lund, Sweden.

A study is made of the production mechanisms for the reaction $p + p \rightarrow p + p + 2\pi^+ + 2\pi^-$ at 28.5 GeV/c in a hydrogen bubble chamber. The $\Delta(1236)$ and the $\rho(760)$ are produced strongly. Also enhancements suggest the production of the isobars N*(1520) and N*(1690). The multiperipheral model and the bremsstrahlung model are used to interpret the data. (J.F.P.)

34526 (CERN-HERA-69-2) DATA COMPILATION OF ANTIPROTON-PROTON REACTIONS INTO ANTIHYPERON-HYPERON. Sadoulet, B. (European Organization for Nuclear Research, Geneva (Switzerland)). Apr. 20, 1969. 139p. Dep.

A compilation of existing data on the differential cross sections for the reactions $\bar{p}p \rightarrow \bar{\Lambda}\Lambda$, $\Lambda\Sigma^0$, $\Sigma^+\bar{\Sigma}^+$, $\Lambda\bar{Y}^*(1385)$, $\Lambda\bar{Y}^*(1405)$, $\Lambda\bar{Y}^*(1520)$, $\Sigma^+\bar{Y}^*(1385)$, $\Sigma^0\bar{Y}^*(1405)$, $\Sigma^0\bar{Y}^*(1520)$, $Y^*(1385)\bar{Y}^*(1385)$ is presented. (auth)

34527 (NYO-2171-275) PRODUCTION OF ω IN THE REACTION $p + d \rightarrow {}^3He + \omega^0$ USING A NOVEL MISSING-MASS SPECTROMETER. Brody, H.; Groves, E.; Van Berg, R.; Wales, W.; Maglic, B.; Norem, J.; Schluter, R.; Cvijanovich, G. (Pennsylvania Univ., Philadelphia). May 1969. Contract AT(30-1)-2171. 11p. Dep. CFSTI.

Preliminary data from the $p + d \rightarrow {}^3He + x^0$ interaction at a proton energy of 3 GeV is presented. A clear ω peak is shown above a smooth background. A new-style missing-mass spectrometer is used for detecting the recoil helium-3. (J.F.P.)

34528 EVIDENCE AGAINST AN I = 5/2 BARYON RESONANCE OF MASS 1640 MeV/c^2. Danburg, Jerome S. (Univ. of California, Berkeley); Davies, Donald W.; Dahl, Orin I.; Hoch, Paul L.; Kirz, Janos; Miller, Donald H.; Rader, Robert K.; Abolins, Maris A.; Delikaris, Thalis; Smith, Gerald A. Phys. Rev. Lett., 23: 41-2 (July 7, 1969).

Recently evidence has been presented for the production of an I =

$\frac{5}{2}$ nonstrange baryon resonance of mass ≅1640 MeV/c^2 in the reaction $\pi^- d \rightarrow (p)n\pi^-\pi^-\pi^+$. With much greater statistics, data for the charge-symmetric reaction fail to show any evidence for such a resonance. (auth)

34529 SEARCH FOR A GRAVITY SHIFT IN THE PROTON LARMOR FREQUENCY. Young, B. Arlen (Varian Associates, Palo Alto, Calif.). Phys. Rev. Lett., 22: 1445-6(June 30, 1969).

An experiment was performed which placed an upper limit of 0.3 Hz on the gravity shift of the proton Larmor frequency rather than 31 ± 10 Hz as reported in the literature. (auth)

34530 ANGULAR DISTRIBUTION OF SECONDARIES PRODUCED IN NUCLEAR INTERACTIONS AT approximately 10^{12}eV. Kim, C. O.; Hwang, S. I. (Korea Univ., Seoul). New Phys. (S. Korea), 8: 93-9(Dec. 1968). (In Korean).

A systematic analysis of the angular distribution of secondaries of forty-four proton, neutron and alpha jets, found in the two large emulsion stacks of Texas and Brawley flown at high altitude by large balloons, ($N_h \leq 3$, 0.2×10^{12} eV $\leq E_p \leq 1.5 \times 10^{12}$ eV in the Texas stack; $N_h \leq 5$, 0.6×10^{12} eV $\leq E_p \leq 6.3 \times 10^{13}$ eV in the Brawley stack) was performed in terms of $\eta(\theta)$. The results generally confirm the previously observed correlation between σ and E_p, i.e., $\sigma = 0.12 + 0.22 \ln E(\theta)$, where E_p is assumed to be $E(\theta)$. But three jets which had small σ and large $E(\theta)$ deviate appreciably from it. The average of the parameter $\kappa(\equiv\sigma/\langle|\eta(\theta) - \langle\eta(\theta)\rangle|\rangle)$ is found to be 1.19 ± 0.01, whose significance is discussed with several analytical forms with adjustable parameters. (auth)

34531 EVIDENCE FOR A NON-STRANGE I = 1 MESON OF MASS 1540 MeV. Aguilar-Benitez, M. (CERN, Geneva); Barlow, J.; Jacobs, L. D.; Malecki, P.; Montanet, L.; D'Andlau, Ch.; Astier, A.; Cohen-Ganouna, J.; Della-Negra, M.; Loerstad, B. Phys. Lett., 29B: 379-82(June 9, 1969).

Evidence is presented for the existence of a nonstrange isospin 1 meson with mass $M_0 \approx 1540$ MeV and width $\Gamma_0 \approx 40$ MeV decaying into $K^* \bar{K}$ and $\bar{K}^* K$. Spin-parities preferred are 2^- and 1^+ (1). (auth)

Strong (Meson-Induced)

Refer also to abstracts 33399, 33502, and 33511.

34532 (JNR-1040) CROSS-SECTIONS FOR THE MESON-BARYON TWO-BODY REACTIONS AND THE QUARK MODEL. Hofmokl, T.; Szeptycka, M. (Institute of Nuclear Research, Warsaw (Poland)). 1968. 14p. Dep.

A comparison is presented of the predictions of the quark model with the existing experimental data for the production of pseudoscalar and vector mesons in two-body reactions with charge exchange but no strangeness exchange. (auth)

34533 (JINR-P1-4412) INVESTIGATION OF CHANNELS OF THE REACTION $\pi^- + p \rightarrow n + \pi^+ + \pi^- + m\pi^0$ AT pc = 4 GeV. Grishin, V. G.; Iresh, M.; Kopylova, D. K.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1969. 27p. (In Russian). Dep.

The reaction $\pi^- + p \rightarrow n + \pi^+ + \pi^- + m\pi^0$ (1) was studied using a 24-liter propane bubble chamber of the Laboratory of High Energies, JINR at an incident π^--meson momentum p = 4 GeV/c. There were 150,000 pictures scanned and 2,374 events observed. The cross sections of channels in the reaction (1) are $\sigma(\pi^- p \rightarrow n\pi^+\pi^-\pi^0) = (2.5 \pm 0.7+)$mb, $\sigma(\pi^- p \rightarrow n\pi^+\pi^-2\pi^0) = (1.6 \pm 0.5)$mb, $\sigma(\pi^- p \rightarrow n\pi^+\pi^-3\pi^0) = (0.5 \pm 0.2)$mb, $\sigma(\pi^- p \rightarrow n\omega\pi^0) = (0.8 \pm 0.2)$mb. The momentum and angular distributions of π^+-mesons in c.m.s. are represented. (auth)

34534 (JINR-P1-4445) MEASUREMENT OF THE REAL PART OF THE ELASTIC π-p SCATTERING AMPLITUDE IN THE COULOMB INTERFERENCE REGION BY USING THE FILMLESS SPARK CHAMBER SPECTROMETER ON LINE TO COMPUTER. Vorob'ev, G. G.; Govorun, N. N.; Golutvin, I. A.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1969. 24p. (In Russian). Dep.

New data on the check of dispersion relations are given, which are obtained from the analysis of the elastic π-p scattering angular distribution in the Coulomb interference region. A new technique on line to computer was used for measurements. Necessary statistical material was accumulated due to development and application of a new system of selective triggering based on the principle of detection of scattering acts according to the change in the direction of cone axis of the Cherenkov radiation. (auth)

34535 (PPAR-12) CROSS SECTION FOR $\pi^- p \rightarrow \Lambda K^0$: STRUCTURE NEAR SIGMA THRESHOLD. Van Dyck, O.; Blumenthal, R.; Frankel, S.; Highland, V.; Nagy, J.; Sloan, T.; Takats, M.; Wales, W.; Werbeck, R. (Princeton-Pennsylvania Accelerator, Princeton, N. J.). June 10, 1969. Contract AT(30-1)-2171. 12p. Dep. CFSTI.

The cross section for the reaction $\pi^- p \rightarrow {}_\Lambda K^0$ was measured at nine beam energies from 790 to 1060 MeV, with a beam resolution of ±1%. The results indicate that a strong, narrow ($\Gamma \lesssim 20$ MeV) peak in the cross section lies within the energy bin centered at 893 MeV. (auth)

34536 (SLAC-PUB-596) A STUDY OF LAMBDA P MASS SPECTRUM FROM THE REACTION: $K^- D \rightarrow \pi^- P\Lambda$ AT REST. Tan, Tai Ho (Stanford Linear Accelerator Center, Calif.). May 1969. 9p. (CONF-690503-2). Dep. CFSTI.

From International Conference on Hypernuclear Physics, Argonne, Ill.

An experiment for the study of hyperon nucleon production in $K^- + d \rightarrow \pi^- + p + \Lambda$ interactions at rest was performed using a deuterium bubble chamber. The results of this experiment are presented, in particular a detailed analysis of the Λp mass spectrum near the 2129 MeV region was studied to determine the nature of the observed enhancement. (J.F.P.)

34537 SINGLE PION PRODUCTION IN $\pi^- p$ COLLISIONS AT 7.0 GeV/c. Ijaz, M. A.; Naeem, A. (Virginia Polytechnic Inst., Blacksburg). J. Natur. Sci. Math., 8: 147-56(Oct. 1968).

Results on 500 completely analyzed two-prong events from an experiment in which the Brookhaven 80'' liquid hydrogen bubble chamber was exposed to a 7.0-GeV/c negative pion beam are presented. The cross section for the two-prong interactions is 11 ± 2 mb. The partial cross section for the reactions $\pi^- p \rightarrow \pi^- p\pi^0$ and $\pi^- p \rightarrow \pi^-\pi^+ n$ is 0.7 ± 0.15 and 1.0 ± 0.2 mb respectively. The ratio ($\pi^- p \rightarrow \pi^- p\pi^0 / \pi^- p \rightarrow \pi^-\pi^+ n$) is consistent with theoretical predictions. Center of mass angular distributions of the particles in the final state of reactions $\pi^- p\pi^0$ and $\pi^-\pi^+ n$ display peripheral character of the collisions. (auth)

34538 η PRODUCTION IN $K^- + p \rightarrow \Lambda + \eta$ AND SOME NEW RESULTS ON THE η DECAY MODES. Cox, B. B.; Fortney, L. R.; Carpenter, D. W.; Rose, C. M.; Smith, W.; Fowler, E. C. Acta Phys. Austr., Suppl. 5, 477-510(1968).

From 7th International Proceedings of Particles, Currents, Symmetries, Schladming, Austria. See CONF-680217.

The question of establishing the existence of a resonance at threshold for $\Lambda + \eta$ production in $K^- + p$ interactions is studied and also measurement of the branching ratios of η decay is performed. This experiment is incomplete, but some results are presented. (J.F.P.)

34539 IS THE L A MESON. Barbaro-Galtieri, Angela (Univ. of California, Berkeley); Davis, Philip J.; Flatte, Stanley M.; (and others). Phys. Rev. Lett., 22: 1207-10(June 2, 1969).

The $K\pi\pi$ enhancement at 1780 MeV (the ''L meson'') is copiously produced in our $K^+ p$ experiment at 12 GeV/c. It is shown that this ''meson'' can be explained as a threshold enhancement in the $K_N(1420)\pi$ system. No evidence is seen for this enhancement in channels other than $K_N(1420)\pi$. (auth)

34540 OBSERVATIONS OF A_1^-, A_2^-, AND HIGHER-MASS BOSONS PRODUCED NEAR 180° IN $\pi^- p \rightarrow p$ (MISSING MASS)$^-$ AT 16 GeV/c. Anderson, E. W. (Brookhaven National Lab., Upton, N. Y.); Bleser, E. J.; Blieden, H. R.; (and others). Phys. Rev. Lett., 22: 1390-4(June 23, 1969).

Observations are reported of A_1^-, A_2^-, and higher mass bosons produced near 180° in $\pi^- p \rightarrow pB^-$ at 16 GeV/c, where B^- denotes missing mass with negative charge. Differential cross sections for pA_1^- and pA_2^- final states are given. Data obtained in the mass range $1.40 \leq M_B - \leq 2.66$ GeV are presented and compared with existing evidence for high mass bosons produced near 0°. (auth)

34541 CAPTURE OF NEGATIVE K-MESONS IN DIAMOND-LOADED EMULSIONS. II. Chinn, L. (Univ. of Washington, Seattle); Lord, J. J.; Piserchio, R. J.; Davis, D. F. Contracts 477(12); N00014-68-C-0121. Nuovo Cim., 62A: 10-16(July 1, 1969).

Nuclear emulsions loaded with small diamond crystals were exposed to a stopping beam of K^--mesons. A total of 43 K^--capture events in carbon were found. Comparisons were made between the K^- absorptions in carbon and normal G-5 emulsion. The results showed that charged $\Sigma\pi$-pair production is depressed in carbon. In addition, an excess of Σ^- to Σ^+ hyperons was observed. If carbon is representative of light emulsion nuclei, then the conventional techniques used for separating events into capture by light and heavy nuclei are shown to be inadequate. (auth)

34542 OBSERVATION OF A_1^{+0} PRODUCTION IN $K^+ p$ INTERACTIONS AT 12.7 GeV/c. Berlinghieri, J. C.; Farber, M. S.; Ferbel, T.; Holmes, R.; Slattery, P. F.; Stone, S.; Yuta, H. (Univ. of Rochester, N. Y.). Phys. Rev. Lett., 23: 42-5(July 7, 1969).

Statistically significant peaks were observed in the charged and neutral three-pion mass spectra at the position of the A_1 in the reactions $K^+ + p \rightarrow K^{0,(+)} + p + \pi^+ + \pi^- + \pi^{+,0}$ at 12.7 GeV/c. The possible interpretation of these peaks is discussed. (auth)

34543 CROSS SECTION FOR $\pi^- p \rightarrow \Lambda K^0$: STRUCTURE NEAR Σ THRESHOLD. Van Dyck, O.; Blumenthal, R.; Frankel, S.; Highland, V.; Nagy, J.; Sloan, T.; Takats, M.; Wales, W.; Werbeck, R. (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Lett., 23: 50-2(July 7, 1969).

The cross section for the reaction $\pi^- p \rightarrow \Lambda K^0$ was measured at nine energies from 790 to 1060 MeV, with a beam resolution of ±1%. The results indicate that a strong, narrow ($\Gamma \leq 20$ MeV) peak in the cross section lies within the energy bin centered at 893 MeV. (auth)

34544 STUDY OF $D^0 \rightarrow \pi^+ \delta^-$ AND $\delta^- \rightarrow \pi^- \eta$ IN THE REACTION $\pi^+ d \rightarrow p_s p D^0$ AT 2.7 GeV/c. Campbell, J. H.; Lichtman, S.; Loeffler, F. J.; Miller, D. H.; Miller, R. J.; Miller, W. J.; Willmann, R. B. (Purdue Univ., Lafayette, Ind.). Phys. Rev. Lett., 22: 1204-7(June 2, 1969).

In $\pi^+ + d$ interactions at 2.7 GeV/c the D^0 mesons with mass 1.27 ± 0.01 GeV/c^2 and width 30 ± 15 MeV/c^2 was observed to decay into the δ^- meson with mass 0.98 ± 0.01 GeV/c^2 and width 40 ± 15 MeV/c^2. The δ^- meson is further observed to decay into $\pi^- \eta$ with both neutral and charged decays of the η. (auth)

34545 NUCLEAR INTERACTIONS PRODUCED BY 20-GeV/c PIONS IN NUCLEAR EMULSION. Park, Jai Nyun (Korea Univ., Seoul). New Phys. (S. Korea), 8: 100-6(Dec. 1968). (In Korean).

Angular distributions of charged secondaries of 319 nuclear interactions ("jets") produced by magnetically analyzed 20-GeV/c pions in nuclear emulsion, were studied. The averages of $\langle\eta(\theta)\rangle$, $\langle|\eta(\theta)|\rangle$, as a function of n_s and N_h, were well fitted by a least-squares method to a formula, $A + B/n$, where n is the total number of secondaries in a jet estimated from n_s with several plausible assumptions. The variation of the values of A with N_h had the same trends as that of 30-GeV/c jets produced by protons in nuclear emulsion, while the value of B was consistently independent of N_h and n_s and equal to 2.8 ± 0.8. The standard deviation of $\eta(\theta)$ distribution, σ, does not seem to depend strongly either on n_s or on N_h. (auth)

Particle Interactions and Properties (Theoretical)

General

34546 (AD-679890) MARKOV PROCESSES WITH CREATION OF PARTICLES. Silverstein, M. L. (Princeton Univ., N. J. Dept. of Mathematics). Feb. 13, 1967; Revised May 9, 1967. Contract DA-31-124-ARO(D)-30. 26p. (AROD-264:77). CFSTI.

The connection with a semigroup of nonlinear operators is exploited to prove an existence theorem. A rigorous description of the process is provided which does not depend on any scheme for indexing particles. (auth) (USGRDR)

34547 EFFECTS OF COMPOSITE FIELDS ON CURRENT ALGEBRA AND GENERALISED WARD'S IDENTITIES. Yoshimura, T. (Univ. of Adelaide). Nucl. Phys., B10: 675-82(1969).

It is shown that the commutation relations between currents and divergences of currents are modified by the introduction of fields corresponding to composite bosons, so that theories with and without a composite field are not equivalent. Equivalence conditions for one-fermion propagator, vertex parts, etc., cannot be cast in as eigenvalue problems. (auth)

34548 MODELS OF LOCAL CURRENT ALGEBRA. Leutwyler, H. (Univ., Bern). Acta Phys. Austr., Suppl. 5, 320-52 (1968).

From 7th International Proceedings of Particles, Currents, Symmetries, Schladming, Austria. See CONF-680217.

It is pointed out that the infinite momentum limit has a simple interpretation in terms of quantities associated with a lightlike surface and the "local current algebra relations at infinite momentum" are derived without making use of the infinite momentum limit. Two models satisfying these relations are then described: A trivial solution with degenerate mass spectrum and a solution that exhibits mass splitting. In particular the significance of ghost states with spacelike momentum arising in nontrivial solutions of the local current algebra relations are described. (auth)

34549 PARTICLES AND THEIR INTERACTIONS. Powles, J. G. Reading, Mass., Addison-Wesley Publishing Company, Inc., 1968. 272p. $4.95.

The discussion of particles and their interactions covers the theory of atoms and molecules and their dimensions, dynamics, and interactions. Relativistic particles, the nature of space and time, statistics for many-body problems, the energy-level distribution of particles, the second law of thermodynamics, and the partition function are considered. Also nonclassical distributions and strongly interacting particles are covered. (J.F.P.)

34550 ULTIMATE PARTICLES OF MATTER. Lewis, D. T. (Lab. of the Government Chemist, London). Lab. Pract., 18: 531-7(May 1969).

A three-entity theory is suggested for the generic structure of subnuclear particles, based on rest-mass values of the better-known particles which have been experimentally determined during the past 20 years. The theory also defines the structure of the electron. The three entities are known as the "tamaid," the "back," and the "Zeus." (auth)

34551 AN INVERSE APPROACH TO A BETHE–SALPETER EQUATION. Blazek, M. (Inst. of Physics, Bratislava). Acta Phys. Aust., 28: 267-71(1968).

A method is presented which allows one to obtain the Bethe–Salpeter equation for two Dirac particles together with the appropriate interaction by postulating the analytical structure of the scattering amplitude in the complex total energy plane for the physical angles, together with the asymptotics of the states. In the model under consideration, the one-pole approximation for the force singularities in a partial wave amplitude is discussed in more detail. The interaction, obtained in this way, decreases exponentially at large four-dimensional distances ρ, while at small distances, it behaves like $(\rho^2 \ln \rho)^{-1}$ for $n = 1$ and it diverges quadratically for $n \geq 2$; n is the four-dimensional angular momentum quantum number. (auth)

34552 HIGH ENERGY PHYSICS INDEX. Volume 7, Number 8, 1969. Frankfurt am Main, Zentralstelle fuer Atomkern-energie-Dokumentation, 1969. 54p.

34553 HIGH ENERGY PHYSICS INDEX. Volume 7, Number 9, 1969. Frankfurt am Main, Zentralstelle fuer Atomkern-energie-Dokumentation, 1969. 54p.

Electromagnetic

Refer also to abstracts 34249, 34281, 34284, 34289, and 34619.

34554 COMPTON SCATTERING OF DEUTERONS. Tret'yakov, V. N. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk, No. 4, 109-16(1968). (In Russian).

A formula for the cross section of elastic scattering of photons on dueterons was calculated using the impulse approximation. The results of the estimate, which was performed on the basis of the proton and also the neutron amplitudes including the corrections for exchanges forces, were represented on four diagrams for scattering angles of 90, 110, and 140° at 60 to 260 MeV in the cms system and 50 and 90° at 60 to 140 MeV in the laboratory system. These results are discussed. (tr-auth)

34555 HADRONIC CONTRIBUTIONS TO THE MUON g-FACTOR. Gourdin, M. (Faculte des Sciences, Orsay, France); de Rafael, E. Nucl. Phys., B10: 667-74(1969).

Using recently reported results from the Orsay colliding beam experiments, a new estimate was made of the hadronic contributions to the anomalous magnetic moment of the muon due to vacuum polarization corrections. (auth)

34556 ZERO MASS THEOREMS AND ANALYTIC CONTINUATION. Kummer, W. (Inst. fuer Hochenergiephysik, Vienna). Acta Phys. Austr., Suppl. 5, 226-44(1968).

From 7th International Proceedings of Particles, Currents, Symmetries, Schladming, Austria. See CONF-680217.

The investigation of dynamical models by which variations caused by the mass variable may be explained in terms of other experimentally known quantities is considered. The continuation in one mass is discussed. The calculations are based on unsubtracted dispersion relations for the invariant functions in the divergences of the currents. The advantages of the reduction technique with functional derivatives is emphasized because the gauge method is readily formulated in this way. A treatment of the dispersion relation appearing in Goldberger–Treiman-like relations and especially the problem of $\pi^0, \eta \rightarrow 2\gamma$ decays is given. (J.F.P.)

34557 RADIATIVE CORRECTIONS IN ELEMENTARY PARTICLE PHYSICS. Kaellen, Gunnar (Univ. of Lund, Sweden). pp 67-132 of Springer Tracts in Modern Physics. Vol. 46. Hoehler, G. (ed.). Berlin, Springer-Verlag, 1968.

A comprehensive treatment is given of the theory and calculations of radiative corrections to muon decay, neutron β decay, and mesonic two- and three-particle decays. (L.B.S.)

34558 A THEORETICAL ENERGY PARADOX IN THE LORENTZ–DIRAC–WHEELER–FEYNMAN–ROHRLICH ELECTRODYNAMICS. Cloetens, W. J. M.; Castillo, B.; De Escobar,

E.; Merlos, R. (Univ. de El Salvador, San Salvador). Nuovo Cim., 62A: 247-54(July 1, 1969).

The Lorentz–Dirac–Wheeler–Feynman–Rohrlich equation of motion of a charged particle is deduced by considering a special case of the Sommerfeld, Markoff, Bohm–Weinstein and Shih–Prastein–Erber equations of motion. It is proved for classical examples that (1) there is conservation of energy in the Lorentz–Dirac–Wheeler–Feynman–Rohrlich electrodynamics for the "good solution" of these theories and time-dependent (one-dimensional) forces; (2) there appears a theoretical "paradox" for the constant homogeneous magnetic field. Here the total radiation is bigger than the initial kinetic energy! Here there is no conservation of the total observable energies. (auth)

34559 LOW-ENERGY THEOREMS FOR SPIN-1 COMPTON SCATTERING. Choudhury, S. R. (Univ. of Michigan, Ann Arbor). Nuovo Cim., 62A: 199-208(July 1, 1969).

Using analyticity, the classical low-energy theorems are derived for Compton scattering of a spin-1 target. Exploiting the threshold behavior the quadrupole-moment theorem recently given by Pais can also be derived. (auth)

34560 K^+–K^0 AND p–n MASS DIFFERENCES. Patil, S. H. (Univ. of Delhi). Nuovo Cim., 62A: 1-9(July 1, 1969).

It is suggested that the high- and low-energy contributions are both important and together can explain the K^0–K^+ mass difference quite well. The high-energy contribution is analyzed in terms of a quark-Regge hybrid model which is shown to be consistent with the finite-energy sum rule. For the low-energy contribution, use is made of the ghost dominance as suggested by Zachariasen, for which a two-channel $\bar{K}K$, $\pi\eta$ dynamics is used. It is also pointed out that one may need to use different form factors for high- and low-energy contributions. (auth)

34561 ON THE EINSTEIN–BOHR IDEAL EXPERIMENT. II. Halpern, Otto (American Express Co., London). Acta Phys. Aust., 28: 356-8(1968).

Utilizing previous results the magnitude of the numerical factor which enters the uncertainty principle if applied to the ideal Einstein–Bohr experiment is studied. (auth)

34562 PHOTOPRODUCTION OF PIONS FROM DEUTERONS IN IMPULSE APPROXIMATION. Franzen, G. (Univ., Bonn). Z. Phys., 225: 99-120(1969).

The differential cross section for photoproduction of pions from deuterons is calculated in the relativistic impulse approximation. In the discussion of the resulting formula special emphasis is given to the following three problems; test of the impulse approximation test of the photoproduction amplitudes, and measurement of the deuteron wave function. (auth)

34563 ON THE UNCERTAINTY PRINCIPLE. II. Halpern, Otto (American Express Co., London). Acta Phys. Aust., 28: 353-5(1968).

The numerical factor entering into the uncertainty principle is discussed. It is suggested that several ideal experiments lead to values for the uncertainty product that are larger than $h/(2\pi)$. (auth)

34564 ELECTRODYNAMICS OF EXTENDED CHARGE STRUCTURES. Shih, Hsio-chang; Erber, Thomas (Illinois Inst. of Tech., Chicago). Acta Phys. Aust., 28: 325-35(1968).

A convenient framework is provided for the effective calculation of a variety of electrodynamic phenomena, such as the collective dynamics of beam bunches in guide structures such as electron tubes, accelerators, storage rings, and plasma bottles, acceleration during Cherenkov radiation, the negative radiation reaction, complex Doppler radiation, and ultrastrong accelerations. The canonical formalism has the desirable feature that previous relativistic extensions may always be constructed. Systematic use is made of Fourier representations for the sources and radiation fields. (J.F.P.)

34565 EVALUATION OF THE MOVING CUT CONTRIBUTIONS TO THE PHOTOPRODUCTION OF PSEUDOSCALAR MESONS. Kaidalov, A. B.; Karnakov, B. M. (Institut for Theoretical and Experimental Physics, Moscow). Phys. Lett., 29B: 376-8(June 9, 1969).

The contributions of the cuts in j-plane to the processes of photoproduction of pseudoscalar mesons at small angles are evaluated by means of the diagram technique. (auth)

Weak

Refer also to abstracts 34289, 34557, and 34592.

34566 (JINR-P2-4382) ISOTOPIC RATIOS FOR PARTICLES REFERRING TO ONE ISOTOPIC MULTIPLET. Dumbrais, O. V.; Podgoretskii, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1969. 15p. (In Russian). Dep.

The processes, in which some final particles refer to one isotopic multiplet, are analyzed. The ratios are obtained between the cross sections or disintegration probabilities for configurations, which differ one from the other by the momentum commutation of the particles considered. Additional ratios are given for the case when some of isotopic amplitudes are small in comparison with the others. The obtained results may be of use both for the check of the selection rules and for the investigation of the reactions for which a direct measurement of the effective cross sections is difficult. (auth)

34567 ROLE OF STRONG INTERACTIONS AND THE INTERMEDIATE BOSON IN THE RADIATIVE CORRECTIONS TO WEAK PROCESSES. Sirlin, A. (New York Univ., N. Y. International Centre for Theoretical Physics, Trieste, Italy). Acta Phys. Austr., Suppl. 5, 353-90(1968).

From 7th International Proceedings of Particles, Currents, Symmetries, Schladming, Austria. See CONF-680217.

Two methods for radiative corrections to weak interactions are considered. One assumes the validity of current algebra at small distances. Within this context two models are discussed. One model assumes a special form for the space–space part of the current algebra, the other model assumes the existence of the intermediate boson. The other method does not assume current algebra and attempts to show some general properties of the second-order corrections which are apparently independent of the details of the strong interactions and the possible existence of the intermediate boson. The approach consists essentially in separating out in a finite and gauge invariant manner the contributions of order $1/k$ as $k_\mu \to 0$ (k_μ is the photon four momentum) in the hadronic covariants. (J.F.P.)

34568 SEMILEPTONIC WEAK DECAY PROCESSES. Pietschmann, H. (Univ., Bonn. Univ., Vienna). Acta Phys. Austr., Suppl. 5, 88-125(1968).

From 7th International Proceedings of Particles, Currents, Symmetries, Schladming, Austria. See CONF-680217.

The discussion of semileptonic weak decay processes emphasizes form factors describing the effect of strong interactions on these processes. The formalism for semileptonic weak decay processes is constructed and represents a unified description of the empirical material without additional assumptions. The consequence of three additional assumptions (G-parity properties, conserved vector current, and Cabibbo assumptions) are derived. Also some recent developments in the form factor physics of three-body leptonic $K^\pm$ decay are given. (J.F.P.)

34569 SELECTION RULE FOR P-WAVE NONLEPTONIC HYPERON DECAYS AS A CONSEQUENCE OF DUALITY. Suzuki, Mahiko (Tokyo Univ.). Phys. Rev. Lett., 22: 1217-19 (June 2, 1969).

A selection rule for p-wave amplitudes of nonleptonic hyperon decays is derived from the duality principle. It predicts $P(\Sigma^-) = 0$ and $P(\Omega^- \to \Xi\pi) = 0$. (auth)

34570 LEADING DIVERGENCES TO ALL ORDERS OF WEAK INTERACTIONS. Iliopoulos, J. (CERN, Geneva). Nuovo Cim., 62A: 209-28(July 1, 1969).

The results obtained recently about the leading divergences in lowest-order nonleptonic weak matrix elements are extended to all orders of perturbation theory. (auth)

34571 $\Delta T = 1/2$ RULE AND THE CABIBBO ANGLE. Ingraham, R. L. (New Mexico State Univ., Las Cruces). Nuovo Cim., 62A: 88-96(July 1, 1969).

A weak-interaction theory based on a total current satisfying the SU_2 current algebra is proposed. Thus SU_3 is broken in a specific way. The nonleptonic $\Delta T = 1/2$ dominance, with about the correct small admixture of $\Delta T = 3/2$, is a consequence of the smallness of the Cabibbo rotation. However, in this model, difficulties with $|\Delta Y| = 2$ and $K \to$ lepton pair processes remain. In a second model, a rotational scalar current term is added, which completely removes these difficulties (due to neutral currents) while leaving an exact $\Delta T = 1/2$ rule. (auth)

Strong (General)

Refer also to abstract 34568.

34572 (CALT-68-198) TOPICS IN ALGEBRAIC PARTICLE PHYSICS. LECTURE 6. THE PARTICLE SPECTRUM FOR CONTRACTED CURRENT COMMUTATORS. Ne'eman, Yuval (California Inst. of Tech., Pasadena). June 1969. Contract AT(11-1)-68. 13p. Dep. CFSTI.

The possibility of keeping the Feynman et al. general sug-

gestion with respect to the composition of the system of hadron states, while using contracted current commutators according to the Lee et al. ansatz rather than the original quark model commutators, is analyzed. The inhomogeneous algebra of integrated contracted current components and the SU(3) content of the irreducible unitary linear representation of G: I^3_{+1} SU(3) are considered. (J.F.P.)

34573 (COO-1051-32) STUDY OF THE PRODUCTION AND DECAY OF RESONANT STATES IN PERIPHERAL HIGH ENERGY COLLISIONS. Williamson, Glenn T. (Michigan State Univ., East Lansing. Dept. of Physics and Astronomy). 1969. Contract AT(11-1)-1051. 102p. Dep. CFSTI.

Thesis.

The current theoretical situation in phenomenological analysis of high energy scattering is reviewed. Various attempts are made to improve upon several models. In particular, the effect of form factors and Regge treatment of propagators on Born amplitudes is examined. Higher-order exchange contributions are considered as possible solutions to the problem of energy dependence of higher spin-exchange amplitudes. It is found that a combination of the absorptive peripheral model and the Regge pole model is the most successful approach, in that energy dependence difficulties are eliminated as is the need for conspiring trajectories. (auth)

34574 (IC-69/43) QUARKS AND COUPLINGS AMONG HADRONS. Mitra, A. N. (International Centre for Theoretical Physics, Trieste (Italy)). June 1969. 36p. (CONF-690607-2). Dep.

From International Conference on Quark Models and Symmetry, Detroit, Mich.

The methods and applications of the quark model as a guide for the construction of hadron couplings is outlined with special reference to the information it provides on the decay widths of various resonances. The quark model and the coupling scheme, couplings among 56 baryons and 36 mesons, supermultiplet classification of hadron resonances, couplings of hadron resonances, and a parametrization for hadron couplings are covered. (J.F.P.)

34575 (NYO-4067-1) ON THE SPACE-TIME DESCRIPTION OF HADRONS. [PART] I. Domokos, G.; Kovesi-Domokos, S.; Mansouri, F. (Johns Hopkins Univ., Baltimore, Md. Dept. of Physics). [1968]. Contract AT(30-1)-4076. 52p. Dep. CFSTI.

The possibility of describing the interactions of composite ("Reggeized") hadrons in space-time is investigated. A formalism is constructed giving a unified description of the spin states of composite hadrons. A Lorentz family of hadron Regge trajectories allows the introduction of local hadron amplitudes. Investigation of the covariance properties of the local hadron amplitudes with respect to proper complex Lorentz transformations, space and time inversion, charge conjugation and gauge transformations establishes the principles according to which observed families of hadron states are described in terms of representations of the complex Lorentz group. It is found that covariance under these transformations necessarily demands parity doubling ("MacDowell symmetry") for meson as well as fermion trajectories. In a world of parallel Regge trajectories (unbroken Lorentz-symmetry) chirality is exactly conserved. A manifestly Lorentz covariant description of the propagation of composite hadrons is given. Explicit expressions of the composite hadron propagators are given for chiral singlet mesons and chiral doublet fermions. Examples of physical assignments are briefly discussed. It is found in particular that particles of unit baryon number transform according to representations of the complex Lorentz group with Toller quantum number $M = \frac{1}{2}$. (auth)

34576 (NYO-4067-2) ON THE SPACE-TIME DESCRIPTION OF HADRONS. [PART] II. Domokos, G.; Kovesi-Domokos, S.; Mansouri, F. (Johns Hopkins Univ., Baltimore, Md. Dept. of Physics). June 16, 1969. Contract AT(30-1)-4076. 44p. Dep. CFSTI.

Interactions of composite (Reggeized) hadrons are investigated. A scheme is given for writing down trilinear vertices between hadrons consistent with Lorentz invariance. The vertices become local when the hadrons involved are put on their mass shells (physical points of the trajectories). A graphical method, similar to Feynman diagrams, is developed for writing down scattering amplitudes involving composite hadrons. The procedure for constructing scattering amplitudes is stated in terms of a few rules. The example of elastic scattering of spinless particles with the exchange of a single Lorentz pole is briefly discussed; it is shown that the diagram rules lead to the well-known expression for a scattering amplitude with rapidly decreasing residues. (auth)

34577 STUDY OF RESONANCES AND FIREBALLS IN THE 10^{11} TO 10^{12} eV RANGE. Roinishvili, N. N. (Inst. of Physics, Tbilisi, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 32: 380-4 (1968). (In Russian).

Identification of isobars, meson resonances, and other short-lived systems in the very high-energy nuclear interactions was studied. At that level, it must be taken into account that the number of possible decay products increases rapidly. The number of possible combinations in resonances which are possible on current accelerators is 5 or 6; there could be 45 two-particle resonances in the 10^{11} to 10^{12} interactions, resulting in an unfavorable ratio between the event and the background. The calculations indicate that the mean accuracy in the measurement of the effective mass for current accelerators is about 30 MeV/c^2; for a resolution up to 60 MeV/c^2 at high energies, the maximum measurable pulse in the system should be about 125 GeV. The formation of fireballs competes with the generation of isobars and meson resonances at high energies, although the asymmetry of the products of interaction and their isotropic decay seemed to indicate that the fireballs could be generated at lower energies of a few hundred GeV. The main problem lies in the effective separation of the two-center events from one-center interactions. In order to examine the effectiveness of the identification, an experiment corresponding to the formation of a fireball was carried out. The results lead in some cases to an incorrect interpretation; none of the methods made it possible to identify clearly the cases involving two fireballs. (TTT)

34578 PARTICLES, CURRENTS, SYMMETRIES. Proceedings Held at Schladming (Steiermark, Austria), 26th February-9th March 1968. Urban, Paul (ed.). Acta Physica Austriaca, Supplementum V. Vienna, Springer-Verlag, 1968. 531p. $22.50; DM 90,-; S 570,-. (CONF-680217).

The conference included 15 papers. Separate abstracts were prepared for all papers. (J.F.P.)

For abstracts of individual papers see: 34289, 34538, 34548, 34556, 34567, 34568, 34603, 34619, 34627, 34628, 34640, 34641, 34654, 34655, and 34662.

34579 THE $U_{6,6}$ PERIPHERAL ABSORPTION MODEL FOR PRODUCTION PROCESSES. Watson, H. D. D.; Migneron, R.; Moriarty, K.; Fincham, D.; Hunt, A. P. (Imperial Coll. of Science and Tech., London). Nuovo Cim., 62A: 127-43 (July 1, 1969).

The absorption model is applied to a wide range of meson-baryon, baryon-baryon, baryon-antibaryon, and photoproduction processes at intermediate energies. $U_{6,6}$ is used to uniquely determine the coupling of the exchanged pseudoscalar and vector mesons. (auth)

34580 TRANSVERSE MOMENTUM OF PARTICLES IN JETS AND DETERMINATION OF FIREBALL PARAMETERS IN ACCELERATORS. Agnese, A.; La Camera, M.; Wataghin, A. (Univ., Genoa. Istituto Nazionale di Fisica Nucleare, Genoa). Nuovo Cim., 62A: 174-80 (July 1, 1969).

The average transverse momentum of the particles of a fireball emitted in a high-energy inelastic collision is calculated as a function of the angle of emission and of the energy available in the c.m.s. A project for the experimental determination of the parameters of the fireballs is also presented. (auth)

34581 QUARK MODEL. Kokkedee, J. J. J. Frontiers in Physics. New York, W. A. Benjamin, Inc., 1969. 251p. $12.50 clothbound; $5.95 paperbound.

This book is based on a series of lectures presented at CERN in 1967. Both theoretical and experimental approaches are used to explore all possible aspects of the quark model theory. The first section introduces the quark notion by analyzing summetry principles in particle physics. The second part contains an examination of the difficulties inherent in the quark hypothesis. In the final section, several applications of the quark idea are discussed, covering such areas as hadron spectroscopy, decay processes and high energy scattering. Reprints of original papers on quarks and composite models are included. (L.B.S.)

Strong (Baryon No. = 0)

Refer also to abstract 34644.

34582 (JINR-P2-4473) STRONG PROCESSES WITH THE PRODUCTION OF SOME PARTICLES BELONGING TO ONE ISOTOPIC MULTIPLET. Dumbrais, O. V.; Podgoretskii, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1969. 22p. (In Russian). Dep.

Strong processes are analyzed in which some finite particles belonging to one isotopic multiplet are produced. The relations were obtained between the reaction cross sections for configurations which differ from each other by momentum interchange of

particles considered. Corresponding modification of the Shmushkevich method was described. (auth)

34583 REACTION AMPLITUDE FOR n-MESONS: A GENERALIZATION OF THE VENEZIANO–BARDAKCI–RUEGG–VIRASORO MODEL. Koba, Z.; Nielsen, H. B. (Univ. of Copenhagen). Nucl. Phys., B10: 633-55(1969).

The Veneziano model for the binary meson reaction (n = 4), generalized by Bardakci and Ruegg and by Virasoro to n = 5, is further extended to the case of arbitrary n. The multi-resonance structure of the n-meson reaction is analyzed with the help of "quark diagrams." An integral representation for the reaction amplitude, its basic properties (recurrence formulas, multi-poles and multi-Reggeization) are presented. A consistent normalization leads to certain relations between coupling constants and trajectory slopes. (auth)

34584 SELECTION RULES FOR ANTINUCLEON–NUCLEON ANNIHILATION. Kosmachev, O. S.; Rus'kin, V. I.; Golyak, I. G. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat., No. 6, 35-50 (Nov.-Dec. 1968). (In Russian).

Selection rules were obtained for the processes of antinucleon–nucleon annihilation with the production of two resonance particles in the final state. (tr-auth)

34585 REGGE-POLE MODEL AND $U_{6,6}$ SYMMETRY FOR $p\bar{p} \rightarrow \Lambda\bar{\Lambda}$. Sundaram, A.; Rao, K. Srinivasa (Inst. of Mathematical Sciences, Madras). Nuovo Cim., 61A: 755-60(June 21, 1969).

The process $p\bar{p} \rightarrow \Lambda\bar{\Lambda}$ is studied using the $U_{6,6}$ symmetry for the vertices and invoking the Regge-pole model for the underlying dynamics. The coupling constants are determined from a knowledge of the πNN coupling constant. Both the angular distribution of the differential cross section and the energy-dependence of the total cross section are satisfactorily reproduced. (auth)

34586 THE EMBEDDING OF NONLINEAR MESON TRANSFORMATIONS IN A EUCLIDEAN SPACE. Isham, C. J. (Imperial Coll. of Science and Tech., London). Nuovo Cim., 61A: 729-36(June 21, 1969).

The equivalence between the linear and nonlinear chiral transformations of the 0^- mesons is demonstrated using a simple form of an embedding theorem of Palais. (auth)

34587 WEINBERG SUM RULES AND THE $\rho\omega\pi$ VERTEX. Niedermayer, F.; Pocsik, G. (Roland Eoetvoes Univ., Budapest). Nuovo Cim., 62A: 372-6(July 1, 1969).

A new sum rule connecting the $\rho\omega\pi$, $A_1\rho\pi$ vertices and the electromagnetic form factor of the pion is found. Its evaluation, for not too large momentum transfers in the pole-dominance approximation, gives the $\rho\omega\pi$ coupling constant in good agreement with the experiments. (auth)

34588 MASS SELECTION, BOSE STATISTICS, AND KINEMATIC ENHANCEMENT. Gleeson, A. M.; Meggs, W. J. (Syracuse Univ., N. Y.). Nuovo Cim., 62A: 181-91(July 1, 1969).

A simple kinematic mechanism is described which enhances the three-pion scattering amplitude at the A_1 mass. This mechanism is based upon the requirements of Bose symmetry, rho-pion scattering dominance and rho mass selection in the final state. The structure of this enhancement is studied and its dependence on the mass selection criteria is shown. (auth)

34589 LOW-ENERGY PION–PION SCATTERING LENGTHS. Lai, C. S. (Dalhousie Univ., Halifax, Can.). Nuovo Cim., 62A: 192-8(July 1, 1969).

The low-energy $\pi\pi$ scattering is treated within the framework of pole-dominance model. It is found that the contribution of the ρ-meson is as important as that of S-waves, and that Weinberg's amplitude of $\pi\pi$ scattering must be corrected to include the ρ contribution. (auth)

34590 THE X^0 WIDTH. Baacke, J.; Jacob, M.; Pokorski, S. (CERN, Geneva). Nuovo Cim., 62A: 332-40(July 1, 1969).

Representing the $X\pi \rightarrow \eta\pi$ reaction amplitude with a Veneziano formula one calculates the X^0 width in terms of f_π. A possible connection with the small width of the δ and the influence of the soft-pion limits is also discussed. (auth)

34591 $\bar{p}p$ ANNIHILATION INTO PIONS IN A REGGEIZED MULTIPERIPHERAL MODEL. Chen, Fong-ching (CERN, Geneva). Nuovo Cim., 62A: 113-26(July 1, 1969).

The phenomenological model of Chan et al. is applied to the the calculation of the cross sections and single-particle angular and momentum distributions of the reaction $\bar{p}p \rightarrow n\pi$, where at most one neutral pion is allowed in the final state. By adjusting only three variable parameters good qualitative agreement is achieved with most experimental data, for multiplicity n between 2 and 9 at incident $\bar{p}$ momentum ranging from 1.61 to 7.0 GeV/c. Interpolation at 2.7 GeV/c and extrapolation to 12.0 GeV/c with the same parameters check satisfactorily with newly available experimental data at these momenta. (auth)

34592 ASYMPTOTIC SU_3 SYMMETRY BREAKING AND STRONG SUPERCONVERGENCE. Hsu, J.-P. (Univ. of Rochester, N. Y.). Nuovo Cim., 62A: 377-82(July 1, 1969).

Several sum rules for the spectral functions are obtained on the basis of the asymptotic SU_3 symmetry breaking, the strong superconvergence of certain invariant amplitudes and the asymptotic $SU_2 \times SU_2$ symmetry. Using these sum rules, the ratio $F_K/F_\pi = 1.24$, the K_{l3} form factors $\xi = -0.92$, $\lambda_- = 0.024$ and the decay widths of the vector mesons are obtained. The results are in good agreement with experiment. (auth)

34593 PARTIAL-WIDTH FORMULATION OF UNITARITY SUM RULES FOR $K_L - K_S$ DECAY. McVoy, K. W. (Univ. of Wisconsin, Madison). Phys. Rev. Lett., 23: 56-9(July 7, 1969).

By including K_S in the background which underlies K_L, S-matrix unitarity can be used to derive a set of constraints on the partial decay amplitudes of the two resonances. The only constraint which does not explicitly involve the strong-interaction background phases is equivalent to the Bell–Steinberger sum rule. (auth)

34594 GAUGE INVARIANCE AND VECTOR-MESON MASS. Dass, Tulsi (Indian Inst. of Tech., Kanpur). Phys. Rev. Lett., 22: 1447-8(June 30, 1969).

It is shown that by coupling the gauge fields to a multiplet of scalar fields it is possible to construct a gauge-invariant mass term for the gauge fields. (auth)

34595 S-MATRIX DESCRIPTION OF K_L AND K_S DECAYS. Durand III, Loyal; McVoy, Kirk W. (Univ. of Wisconsin, Madison). Contract AT(11-1)-881. Phys. Rev. Lett., 23: 59-62 (July 7, 1969).

It is shown how the usual phenomenological description of the decays of the K_S and K_L mesons can be derived in a unified manner beginning from a description of the K_S and K_L states as overlapping resonances in a scattering matrix. The unitarity relations for overlapping resonances in a CPT-invariant (but not CP- or T-invariant) theory play a crucial role in the discussion, and are treated in detail. (auth)

34596 POSSIBILITY OF MATTER–ANTIMATTER SEPARATION AT HIGH TEMPERATURE. Omnes, R. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Phys. Rev. Lett., 23: 38-40(July 7, 1969).

It is suggested, on the basis of a simplified model of nucleon-antinucleon interaction, that a spatial separation of baryons and antibaryons might occur in the blackbody radiation at very high temperatures, typically larger than kT = 350 MeV. Some applications to astrophysical data, like the matter density of the universe and a mechanism for quasistellar objects, are sketched. (auth)

34597 THE ALGEBRA OF CURRENTS AND THE VENEZIANO MODEL: THE $A_1\rho\pi$ SYSTEM. de Alwis, S. P. (Cambridge Univ., Eng.); Nutbrown, D. A.; Brooker, P.; Kosterlitz, J. M. Phys. Lett., 29B: 362-4(June 9, 1969).

A Veneziano-type model is proposed for an amplitude with three pions and an axial-vector current which (a) coincides with the on-shell forms of Lovelace and Goebel et al. at the pion and A_1 poles and (b) satisfies chiral symmetry with $m_\pi = 0$. The consequences for the A_1-ρ-π system are investigated. (auth)

34598 APPLICATION OF UNITARIZED VENEZIANO MODEL TO EXPERIMENTAL DATA. Roberts, R. G.; Wagner, F. (CERN, Geneva). Phys. Lett., 29B: 368-71(June 9, 1969).

Lovelace's unitarized form of the Veneziano model is shown to agree with a large range of experimental data on $\pi\pi$ interactions. (auth)

Strong (Baryon No. = 1)

34599 (JINR-P1-4442) EMPIRICAL DEPENDENCE-RANGE-ENERGY-FOR 100-100000 MeV PROTONS. Vzorov, I. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1969. 7p. (In Russian). Dep.

Empirical relations between the range and the energy of protons are given which are valid for the energy region 100–100,000 MeV. These relations are $R = a(\ln T)^b$, $T = (c)^{R^{1/b}}$ where a, b and c are the parameters depending on the atomic number of the stopping material. (auth)

34600 TWO REGGE TRAJECTORIES IN THE REACTION $\pi^- + p \rightarrow \pi^0 + n$. Derem, A. (CEN, Saclay, France). Nucl. Phys., B10: 619-32(1969). (In French).

The possibility of describing the high-energy reaction $\pi^-p \rightarrow \pi^0n$ with two Regge trajectories $\alpha_\rho(t)$ and $\alpha_{\rho'}(t)$ is studied in more detail. These trajectories are assumed to be exactly linear in t,

with $\alpha_\rho(t)$ constrained to pass through $\alpha_\rho(m_\rho^2) = 1$. Hypotheses are examined in which $\alpha_\rho(t)$ obeys either the Gell–Mann mechanism or or the Chew mechanism, and in which $\alpha_{\rho'}(t)$ is or is not a conspiring trajectory. The model is in good agreement with the data in practically all cases; greater experimental accuracy would be necessary to distinguish between the various hypotheses. Predictions are given for the neutron polarization at $|t| < 1$ GeV^2. (auth)

34601 CONTINUOUS-PARAMETER SUM RULES. Taha, M. O. (International Centre for Theoretical Physics, Trieste, Italy). Nucl. Phys., B10: 656-66(1969).

Using Laplace transform and Regge high-energy behavior, continuous-parameter sum rules are found for strong interaction amplitudes. The finite-energy version of these sum rules is discussed and equations for the Regge parameters obtained. Forward πN scattering is considered as an example and numerical values are found for the parameters of ρ and ρ' trajectories. A mathematical appendix on the incomplete gamma function is added. (auth)

34602 FORWARD SCATTERING IN SOME TWO-BODY REACTIONS INVOLVING $^1/_2{}^+$ BARYONS AND 0^- MESONS AT 3 GeV/c. Barloutaud, R. (CEN, Saclay, France); Derem, A.; Griselin, J.; Merrill, D. W.; Scheuer, J. C.; Goldberg, J.; Rouge, A.; Focardi, S. Nucl. Phys., B10: 683-99(1969).

At 3 GeV/c, forward differential cross sections and polarization distributions in two-body reactions involving $^1/_2{}^+$ baryons and 0^- mesons and charge or hypercharge exchange are compared with the predictions of SU(3) under the assumption that these reactions are dominated by exchange of members of the 1^- and 2^+ meson octets. Good agreement is found independently for reactions in which strange and nonstrange mesons are exchanged. The Reggeization of the t-channel amplitudes with parameters determined at high energy, when associated with a splitting of the trajectories corresponding to strange and nonstrange exchanged mesons, leads to a good description of the forward scattering for all reactions. (auth)

34603 EFFECTIVE LAGRANGIANS IN PARTICLE PHYSICS. Guersey, F. (Middle East Technical Univ., Ankara). Acta Phys. Austr., Suppl. 5, 185-225(1968).

From 7th International Proceedings of Particles, Currents, Symmetries, Schladming, Austria. See CONF-680217.

The equivalence of two methods of obtaining an effective Lagrangian for pion–nucleon interactions is shown. In one method the effective Lagrangian is obtained from the σ model by allowing the mass of the auxiliary σ field to tend to infinity. The elimination of σ by this method results in a nonlinear partially chiral invariant Lagrangian that is identical with the old models. Then by a unitary transformation all nonderivative π–N couplings are changed to a derivative coupling form. This form which is a chiral generalization of the pseudovector coupling of pions with nucleons can also be directly derived by postulating directly the new transformation law for the transformed nucleon field. This law involves the pion field instead of the Dirac matrix. (J.F.P.)

34604 MULTI-REGGE BARYON EXCHANGE AND CENTRAL INTERACTIONS. Caneschi, L.; Pignotti, A. (Univ. of California, Santa Barbara). Phys. Rev. Lett., 22: 1219-23 (June 2, 1969).

It is found that the double differential cross section for pp inelastic collisions at high energy can be well reproduced over a range of two decades by a simple version of the multi-Regge model, in which baryon exchange is responsible for large momentum transfers to the final proton. The model is an asymptotic one, and predictions at 70 and 200 GeV/c are shown. (auth)

34605 MODIFIED FINITE-ENERGY SUM RULES AND THE ρ REGGE PARAMETERS. Chan, C. H.; Chavda, L. K. (Purdue Univ., Lafayette, Ind.). Phys. Rev. Lett., 22: 1228-31(June 2, 1969).

A new type of continuous-moment sum rule is proposed. It retains the flexibility of the usual continuous-moment sum rule but avoids ReF in the low-energy integration. Also, it exploits the low- and intermediate-energy data more efficiently than was possible previously. The sum rule is applied to the forward pion-nucleon charge-exchange scattering to obtain $\alpha_\rho = 0.659 \pm 0.02$ and $\gamma_\rho = 0.0173 \pm 0.001$. (auth)

34606 GENERALIZED SUM RULES FOR WEAK AXIAL VECTOR NUCLEON AMPLITUDES. Micu, M.; Radescu, E. E. (Inst. of Atomic Physics, Bucharest). Nuovo Cim., 61A: 737-46(June 21, 1969).

Using the dispersion relations in the mass variable proposed by Fubini and Furlan, generalized sum rules for weak axial vector nucleon amplitudes are found. From these sum rules an on-mass-shell version of the pion-nucleon spin-flip sum rule is obtained. The model-independent part of the corrections is computed. It is quite small. (auth)

34607 THE COULOMB CORRECTION ON THE $^3/_2\ ^1/_2{}^-$ SCATTERING LENGTH IN π^+–p SCATTERING. Rasche, G. (Univ., Zurich). Nuovo Cim., 62A: 229-31(July 1, 1969).

The Coulomb corrections on a_3 ($^3/_2\ ^1/_2{}^-$ scattering length in π^+–p scattering) were calculated to get the "strictly nuclear part" a_3^N of a_3. The result is $a_3^N - a_3 = 0.003 \pm 0.001$. The error stems from the uncertainties in the extended charge distribution of the p and π^+ and in the range of the nuclear part of the forces. (auth)

34608 PION–NUCLEON BACKWARD SCATTERING AND A MODIFICATION TO THE PERIPHERAL ABSORPTION MODEL. Gault, F. D.; Hartley, B. J.; Migneron, J. H. R.; Moriarty, K. J. M. (Imperial Coll. of Science and Tech., London). Nuovo Cim., 62A: 269-74(July 1, 1969).

The peripheral absorption model with $U_{6,6}$ symmetry imposed at the vertices and a recently proposed modification to the model are applied to backward π^+p scattering and the results compared. (auth)

34609 COMPLEX ZEROS OF SCATTERING AMPLITUDES AND POLARIZATION DATA AT HIGH ENERGIES. Neal, H. A.; Predazzi, E. (Indiana Univ., Bloomington). Nuovo Cim., 62A: 275-89(July 1, 1969).

The connection between polarization and the complex zeros of elastic-scattering amplitudes is examined in an attempt to test the recent prediction that, in analogy to the situation in π-p scattering, minima will occur in the p-p angular distribution at high energies. This prediction is a consequence of a parametrization based on multiple diffraction scattering. A comparison with the existing polarization data shows that the π-p data are consistent with this parametrization whereas no definite conclusion can be drawn for the p-p case. (auth)

34610 THE VECTOR AND AXIAL N–N* VERTICES. CALCULATION FROM THE WARD IDENTITY AND THE SIDEWISE DISPERSION RELATIONS. Casalbuoni, R. (Univ., Florence); Gatto, R.; Longhi, G. Nuovo Cim., 62A: 319-31(July 1, 1969).

A theoretical calculation of the ratio of the form factors H_1 and H_1^5 of the vector and axial N–N* vertices is presented, based on once-subtracted dispersion relations in the nucleon mass. The subtraction constants are evaluated using Ward identities. The absorptive parts of the form factors are calculated with the soft-pion technique and a cut-off procedure is necessary, but the cut-off value can be calculated by consistency, without any further assumptions. The result obtained is $H_1/H_1^5 = -4.2$, which is consistent with other values quoted in the literature. (auth)

34611 ON THE $A\bar{A}$ SYSTEM FROM THE REACTION $\pi^-p \rightarrow A\bar{A}n$. Fischer, W. E. (CERN, Geneva. Eidgenoessische Technische Hochschule, Zurich). Nuovo Cim., 62A: 16-26(July 1, 1969).

A phenomenological discussion is presented of the properties of the $A\bar{A}$-system from the reaction $\pi^-p \rightarrow A\bar{A}n$. Asymmetries in angular distributions and $\Lambda(\bar{\Lambda})$ polarization are explained. Only well-established symmetries and the general laws of quantum mechanics are used. (auth)

34612 VENEZIANO MODEL FOR $\pi\Lambda$ SCATTERING. Antoniou, N. G. (Univ., Tuebingen, Ger.). Z. Phys., 225: 135-8 (1969).

A Veneziano-type amplitude for $\pi\Lambda$ scattering leads to a satisfactory prediction of the mass of the $Y_1^*(1385)$ resonance. The S-wave $\pi\Lambda$ scattering length is found to be small and negative. (auth)

34613 HIGH-ENERGY μ-p SCATTERING AND MUON INTERACTIONS. Flamm, Dieter; Kummer, Wolfgang (Institut fuer Hochenergiephysik, Vienna). Acta Phys. Aust., 28: 251-7(1968).

High energy μ-p scattering experiments provide a valuable tool to study yet undiscovered muon interactions. The consequences of a $0^\pm$, $1^\pm$, and 2^+ muon-proton interaction are investigated with special emphasis on the use of recently developed polarized proton targets. It is pointed out that even without reference to electron scattering data a qualitative indication for a possible 1^+ or 2^+ interaction could be found from small angle scattering experiments. Since the cross section is peaked at small angles also existing low intensity muon beams may give valuable information. By comparison with e-p scattering any deviation from pure quantum-electrodynamics can easily be detected. (auth)

34614 INVESTIGATION OF THE CONTRIBUTION FROM MOVING CUTS TO THE pn-CHARGE EXCHANGE PROCESS. Kaidalov, A. B.; Karnakov, B. M. (Inst. for Theoretical and Experimental Physics, Moscow). Phys. Lett., 29B: 372-5 (June 9, 1969).

The contribution from moving cuts to the amplitude of the forward np charge exchange is investigated by means of the diagram technique. Conditions for the validity of the Reggeon absorption model are discussed. (auth)

Strong (Baryon No. ≥ 2)

34615 (ORNL-TM-2627) HIGH NUCLEAR CASCADES: A PROPOSED APPROACH TO COMPUTER SIMULATION. Gove, N. B.; Bertini, H. W.; Feliciano, M.; Culkowski, A. H. (Oak Ridge National Lab., Tenn.). [nd]. 48p. Dep. CFSTI.

A computer program is proposed to calculate what happens when a high (up to 200 GeV) energy particle strikes a nucleus. The nucleus is first divided into a number of regions. To each region is assigned a density. From the densities and the known cross sections for nucleon reactions, the absorption coefficients are calculated. From the absorption coefficients the distribution function for collision sites is obtained and an event is chosen by a sampling procedure. Meson production is included as a possible event. The developing cascade is followed in discrete time steps. Nuclear matter is conserved by reducing the density in a region which has contributed a particle to the cascade. This leads to a density imbalance which is assumed to cause a flow of nuclear matter into the depleted region. (auth)

34616 CALCULATIONS OF NUCLEON INTRANUCLEAR CASCADES BY THE METHOD OF STATISTICAL SAMPLING. Latypova, R. A. Tr. Fiz. Inst., Akad. Nauk SSSR, 45: 3-6 (1969). (In Russian).

A detailed description is given of the program for calculating intranuclear cascades by the Monte Carlo method. A flow diagram of the program for the M-20 computer is also included. (tr-auth)

34617 THE PROBLEM OF THE UNAMBIGUITY OF PHASE-SHIFT ANALYSIS. II. N-N SCATTERING PHASE-SHIFT ANALYSIS AT ENERGIES NEAR TO 20 MeV. Bilenkaya, S. I.; Bystriskii, I.; Janout, Z.; Kazarinov, Yu. M.; Lehar, F.; Pazman, A. (Joint Inst. for Nuclear Research, Dubna, USSR). Czech. J. Phys., 19: 891-8(1969).

The new results of phase-shift analysis at energies of 23.1 and 18.2 MeV are discussed. Two and three solutions remain at these energies respectively. The measurements of triple n-p scattering parameters are necessary for obtaining the unambiguity of the solutions. It is shown that the Berkeley p-p polarization data at 19.7 MeV are in disagreement with other results. For the discrimination of phase shift solutions the so-called τ-criterion was used. (auth)

34618 PROBLEM OF THE UNAMBIGUITY OF PHASE-SHIFT ANALYSIS. I. DESCRIPTION OF A POWERFUL DISCRIMINATING CRITERION. Pazman, A.; Bilenkaya, S. I.; Bystriskii, I.; Janout, Z.; Kazarinov, Yu. M.; Lehar, F. (Joint Inst. for Nuclear Research, Dubna, USSR). Czech. J. Phys., 19: 882-90(1969).

For the discrimination of phase-shift solutions, the new so-called τ-criterion, based on the calculation of some function τ of the experimental data, is used. This method can be applied, in general, to an arbitrary ambiguous phase-shift analysis. The τ-criterion is more powerful than the χ^2-criterion, e.g., for rejecting a less probable set it is necessary to have a smaller quantity of experimental points (in statistics this means that the τ-criterion gives a smaller Type II error). For the calculation of the quantity τ, the standard program for phase-shift analysis with a small additional part can be used. A computer time of about only 5-10 min on a computer of M-20 type is needed. A Type I error is then obtained from the tables of the normal distribution function. (auth)

34619 ON HIGH ENERGY COLLISIONS OF HADRONS AT VERY LARGE MOMENTUM TRANSFERS. Kastrup, H. W. (Univ., Munich). Acta Phys. Austr., Suppl. 5, 407-51(1968).

From 7th International Proceedings of Particles, Currents, Symmetries, Schladming, Austria. See CONF-680217.

A statistical soft meson model for elastic and inelastic nucleon-nucleon scattering is considered including a description and comparison with experiments, Ericson fluctuations, predictions for experiments, incorporation of unitary symmetries, and a bremsstrahlung model with realistic phase spaces. Electron-nucleon interactions are also discussed covering a model for the electroproduction of soft mesons at large electron momentum transfers and a calculation of the nucleon magnetic form factor for large momentum transfers. (J.F.P.)

34620 DISPERSION RELATIONS AND GLAUBER MODEL FOR PION-DEUTERON SCATTERING. Faeldt, Goeran (CERN, Geneva). Nucl. Phys., B10: 597-611(1969).

Forward dispersion relations are used to calculate the real part of the elastic amplitude for forward pion-deuteron scattering. The same real part is also calculated from the Glauber multiple scattering model. The results of the two approaches are critically compared in the light of present experiments. A theoretically deduced value for the pion-deuteron scattering length is also given. A theoretical prediction for the pion-deuteron total cross section for energies below 450 MeV is found to agree rather well with experiments. (auth)

34621 $\Lambda-\Sigma$ CONVERSION AND Λd $J = \frac{3}{2}$ BOUND STATES. Toepfer, A. J. (Univ. of Southern California, Los Angeles). Nuovo Cim., 61A: 761-5(June 21, 1969).

The effect of virtual $\Lambda N \rightleftharpoons \Sigma N$ transitions on the binding energy of the Λd, $J = \frac{3}{2}$ system was investigated using the Faddeev formalism. Separable potentials were assumed for the two-body interactions and a repulsive core was included in the ΛN potential. A possible three-body bound state was found to be destroyed by assuming a finite coupling to the Σ-channel. (auth)

34622 HYPERON-NUCLEON INTERACTION AT LOW ENERGIES. Fast, G.; Helder, J. C.; de Swart, J. J. (Univ. of Nijmegen, Netherlands). Phys. Rev. Lett., 22: 1453-5(June 30, 1969).

The hyperon-nucleon scattering is described by a potential model. The Σ^+p scattering data require a $^3S_1$ resonance in the Λp scattering, for which resonance there seems to be experimental evidence. Its position and the Σ^+p scattering data determine the Σ^+p effective-range parameters, and combined with the Λp scattering data it determines the Λp effective-range parameters. (auth)

34623 ABOVE THE EXISTENCE OF AN I = 5/2 ISOBAR AT 1,470 MeV. Hegedues, E.; Abramovici, A.; Vekas, K. (Univ. of Timisoara, Rumania). Z. Phys., 225: 121-4(1969).

The possibility that an I = 5/2, Y = 1, M = 1,470 MeV isobar really exists is analyzed, using the experimental data reported previously. The existence of such an isobar in an I = 1 35-plet, was already suggested. (auth)

34624 DEPENDENCE UPON THE TOLLER AZIMUTHAL ANGLE AS A CONSEQUENCE OF POMERANCHUK EXCHANGE IN THE MULTIPHERAL MODEL AT VERY HIGH ENERGIES. Barshay, S. (Univ. of Copenhangen). Phys. Lett., 29B: 365-7(June 9, 1969).

It is shown that when a Pomeranchuk is exchanged from a proton-proton vertex to an internal vertex the distribution in the Toller azimuthal angle ω is given by the distribution as computed from the standard Reggeized matrix element times a polynomial in $\cos\omega$, $A_0 + A_1 \cos\omega + A_2 \cos^2\omega$. It is noted that there is a possibility of a kinematic depression of the effective coupling at an internal vertex for a Pomeranchuk, an external spin-zero boson, and a Reggeized boson with a large spin-zero component, for example at an internal vertex coupling a Pomeranchuk to two pions. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 34638 and 34672.

34625 (ITEF-647) CONCERNING THE QUANTUM MECHANICAL DESCRIPTION OF "PARTICLES" WITH COMPLEX SPIN. Roginskii, V. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1968. 35p. (In Russian). Dep.

The concept of the direct product $T^{S_1} \otimes T^{S_2}$ of two irreducible representations (irreps) of the rotation group is generalized to the case when the weights S_1 and S_2 of these irreps are complex, but the difference $2S_1 - 2S_2$ is an integer; at such values of S_1 and S_2 the representation (rep) $T^{S_1} \otimes T^{S_2}$ is defined as the restriction of the irrep $T^{(S_1,S_2)}$ of the Lorentz group to the rotation group. This method does not enable one to consider a single irrep T^S at complex S. The definition of the rep $T^{S_1} \otimes T^{S_2}$ is used as the basis for generalization to the complex spin case of the concept of two-particle spin wave function (the spin difference $S_1 - S_2$ is to remain a half-integer) and of one-particle spin density matrix. This approach does not make possible the introduction of a wave function of a single "particle" with complex spin, therefore such a "particle" is not observable or is observable to a limited extent only. However the system of two "particles" with complex spins S_1 and S_2 ($2S_1 - 2S_2 = n$) may be in a state with half-integer total spin $|S_1 - S_2|$, $|S_1 - S_2| + 1$, ... ; real particles may correspond to these states. The approach suggested may find use in the theory of unstable particles as well as in the quark theory if, according to I. S. Shapiro, one ascribes complex spin to quarks. (auth)

34626 MASS FORMULAS ASSOCIATED WITH SU(3) MULTIPLETS AND BARYON WAVE EQUATIONS OBTAINED FROM THE GLOBAL UNIFIED DYNAMIC GROUP G = SO(6.1) × U(1). Gueret,

Philippe; Vigier, Jean-Pierre (Institut Henri-Poincare, Paris). Compt. Rend., Ser. B, 268: 1153-6(May 5, 1969). (In French).

If one chooses as a dynamic external group $E = SO(4,1) \times U(1)$, in which SO(4,1) replaces the usual Poincare group and U(1) corresponds to the electromagnetic interactions, one sees that it can be unified in the sense of Flato et al., with SU(3) (strong interactions) and $SU(2) \times SU(2)$ (weak interactions) in a global dynamic group $G = SO(6,1) \times U(1)_B$. $U(1)_B$ is associated with the baryon number. The experimental consequences of the mass formula are analyzed, in particular, it is shown that it is possible to account for mass splitting between isotopic multiplets in an SU(3) representation without breaking the symmetry. The linear wave equations associated with the mass formula are examined. (tr-auth)

34627 DISCRETE SYMMETRIES IN ELEMENTARY PARTICLE PHYSICS. Nilsson, J. (Univ., Goteborg). Acta Phys. Austr., Suppl. 5, 1-87(1968).

From 7th International Proceedings of Particles, Currents, Symmetries, Schladming, Austria. See CONF-680217.

A review is presented of the discrete transformations P, C, and T applied to elementary particle processes. Also covered are the formalism for invariance principles, definitions of the discrete transformations P, C, and T, applications of the CPT theorem, and symmetry principles in general. (J.F.P.)

34628 BREAKING CHIRAL SU(3) ⊗ SU(3). Glashow, S. L. (Harvard Univ., Cambridge, Mass.). Acta Phys. Austr., Suppl. 5, 245-67(1968).

From 7th International Proceedings of Particles, Currents, Symmetries, Schladming, Austria. See CONF-680217.

From the discussion of the breaking of chiral SU(3) ⊗ SU(3) the relation $M^2_{ij}\, T^a_{jk}\, \lambda^a_k = -T^a_{ik}\, \epsilon_k$ was obtained where ϵ were parameters measuring intrinsic symmetry breakdown, λ was the translation which was necessary to remove linear terms in ϕ from the Lagrangian, and M^2_{ij} are the coefficients of the quadratic terms (bare masses) in the translate fields. This result is proven from current algebra. Applications are given for spectral function sum rules, weak decays of mesons, decays of mesons into lepton pairs, and properties of a scalar kaon. (J.F.P.)

34629 K-PARITY FOR SYSTEMS WITH SU_3 AND CHARGE-CONJUGATION SYMMETRY. Dotson, A. C.; Good, R. H. Jr. (Ames Lab., Iowa). Nuovo Cim., 61A: 706-20(June 21, 1969).

An operator is discussed that applies to a system with SU_3 and charge-conjugation invariance, analogous to G-parity for a system with isospin and charge-conjugation invariance. The analogy is not complete because the operator cannot be written in terms of charge conjugation and the abstract SU_3 operations. However, it is well defined in the space produced by free field operators acting on the vacuum, provided that, for each set of fields present that forms the basis of a representation of SU_3, another set is present that forms the basis of the conjugate representation. The K-parity operator has period two and commutes with the SU_3 generators. For any SU_3 and charge-conjugation invariant reaction the possible reaction operators can be classified as scalar or pseudoscalar under K-parity. The K-parity of single-particle meson states is a well-defined quantum number which is conserved for scalar reactions. A discussion is given of three- and four-particle interactions which have a unique interaction operator and hence a definite K-parity. (auth)

34630 CONSTRUCTION OF IRREDUCIBLE REPRESENTATIONS OF $Sp_{4,R}$ BY MEANS OF PARA-BOSON OPERATORS. Alabiso, C. (Univ., Milano); Duimio, F.; Redondo, J. L. Nuovo Cim., 61A: 766-78(June 21, 1969).

The complete solution to the problem of constructing irreducible representations of the creation and destruction operators for a system of two para-oscillators for any order of para-statistics. By means of this result, a class of unitary irreducible representations of $Sp_{4,R}$ algebra, belonging to the discrete series, is explicitly constructed. (auth)

34631 SYMMETRY PROPERTIES OF EIGHT COMPONENT SPINOR FIELDS IN THE LATTICE SPACE. Bopp, Fritz (Univ., Munich). Z. Phys., 224: 209-21(1969). (In German).

Starting from the four-component Dirac equation for free particles without mass W. Heisenberg and W. Pauli have shown that the interaction term is uniquely defined, if one requires that all symmetries of free particles are preserved. Here one obtains similar results if one starts from the eight-component Dirac equation for free particles without mass: 1. The symmetry group of the eight-component Dirac equation for free particles without mass has 16 parameters. It is isomorph to the direct product of the SU 4 and a one-parametric group: SU 4 × (1). 2. The interaction operator is uniquely defined if one requires to preserve as many symmetries as possible of those given in (1). 3. But some of the symmetries in (1) are necessarily broken, in particular that of SU 3. The symmetry of the interaction operator is given by SO 4 × (1) × (1). These results mean: 1. The Heisenberg theory is uniquely defined, only if one assumes that the free particle part of the equation is well known. 2. The theory can be changed without modifying the fundamental idea of Heisenberg and Pauli to deduce an uniquely defined interaction operator if one starts with a modified free particle part. 3. A special kind of modification of the free particle part leads essentially to the SU 4-symmetry including that of SU 3, which is necessarily broken by the interaction term. 4. The question arises if this break of the SU 3-symmetry has something to do with the real break. This question is not yet touched. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstract 34524.

34632 SYMMETRIES AND CURRENT ALGEBRAS FOR ELECTROMAGNETIC INTERACTIONS. Solov'ev, L. D. (Joint Inst. of Nuclear Research, Dubna, USSR). pp 53-66 of Springer Tracts in Modern Physics. Vol. 46. Hoehler, G. (ed.). Berlin, Springer-Verlag, 1968.

The main predictions of SU(6) symmetry for electromagnetic interactions are briefly considered. A survey is given of current algebra applications to electromagnetic interactions through 1966. 90 references. (L.B.S.)

34633 POSSIBLE CHARGE ASYMMETRY IN RADIATIVE $\tau^\pm$ DECAYS. Dass, G. V.; Kabir, P. K. (Rutherford High Energy Lab., Chilton, Eng.). Phys. Rev. Lett., 22: 1224-7(June 2, 2969).

A phenomenological discussion is given, together with an estimate of the magnitude, of the possibly quite large CP-noninvariant effects which may be present in $K_\pm \to \pi^\pm\pi^+\pi^-\gamma$ decays. (auth)

34634 AN SU(6) ESTIMATE OF THE EFFECTIVE NON-LEPTONIC PARITY-VIOLATING COUPLING IN STRANGENESS-CONSERVING WEAK PROCESSES. Kummer, W. (Institut fuer Hochenergiephysik, Vienna); Schweda, M. Acta Phys. Aust., 28: 303-8(1968).

Using simple SU(6)-symmetry for the S-waves in the weak baryon-meson vertex it is shown that an older SU(3) result for the nonleptonic parity violating coupling in strangeness conserving processes is reproduced. In the new derivation untenable assumption of R-invariance is completely avoided. (auth)

Applications (Strong)

34635 (PITHA-26) NEUTRAL KAONS AND CP. Faissner, H. (Technische Hochschule, Aachen (West Germany). Physikalisches Institut (III)). [1968]. 108p. Dep.

A phenomenological study of neutral kaons and CP is presented. The topics discussed include neutral kaons in strong and weak interactions, quantum mechanics of free neutral kaons, the regeneration of neutral kaons in matter, the phenomenology of CP violation in neutral kaon decays, and possible sources of CP violation. (J.F.P.)

34636 DECAYS OF MESONS IN THE U_6 X U_6 X O_3 SYMMETRY SCHEME. Shafi, Q. (Imperial Coll. of Science and Tech., London). Nuovo Cim., 62A: 290-300(July 1, 1969).

Strong two-body decays of mesons belonging to the $(6,\bar{6};\ l = 1)$ representation of the rest symmetry group $U_6 \times U_6 \times O_3$ are considered. Mass splitting is taken into account by introducing phenomenological weighting factors which lead to very good results for the four SU_3 nonets treated independently. The decay rates are inconsistent by only a factor of ≈2.5 when comparisons of the 0^{++}, 1^{++} and 1^{+-} decay rates are made with the $2^{++} \to 0^-0^-$ decay mode. (auth)

Field Theories

General

34637 NON-NULL ELECTROMAGNETIC FIELDS IN CERTAIN RIEMANNIAN FOURFOLDS. Singh, K. P.; Sharan, R.; Singh, D. N. (Banaras Hindu Univ., India). Proc. Nat. Inst. Sci. India, Part A, 35: 1-15(Jan. 1969).

Nonnull electromagnetic fields are considered in the nonstatic cylindrically symmetric space-time represented by Einstein–Rosen metric. The field equations considered are those of Rainich's "already unified theory." The algebraic relations of the field theory give rise to three possible cases of electromagnetic fields. Several exact solutions of the Rainich equations are obtained which represent cylindrically symmetric nonnull electro-

magnetic fields in vacuo. It is found that the electromagnetic fields correspond to electromagnetic wrenches, in the terminology of flat space-time, along one of the spatial coordinated lines. Solutions corresponding to purely electric and magnetic fields are obtained from them as special cases. A product space ($V_3 \times V_1$) is considered. It is shown that the corresponding Riemannian fourfold does not admit nonnull electromagnetic fields. $R_{ij} = 0$ in this case is a necessary and sufficient condition for the fourfold to be flat. Finally, the Liouville form of the line-element is discussed. It is found to be incompatible with nonnull electromagnetic field. The only field of electromagnetic significance which it represents is the well-known plane symmetric null electromagnetic field. (auth)

Quantum Field Theory

Refer also to abstracts 34518, 34557, 34664, and 34675.

34638 CONFORM GROUP, FIELD EQUATION COVARIANCE, AND DIMENSIONAL ANALYSIS. Flato, Moshe; Hillion, Pierre; Simon, Jacques (Institut Henri-Poincare, Paris). Compt. Rend., Ser. A, 268: 1065-8(May 5, 1969). (In French).

A history of the use of the conform group in mathematical physics is given; then the covariance of the field equations (especially those of null mass) is critically discussed through the relation with the conform group. In connection with this, the relation between the conform group and dimensional analysis is established. Several physical inferences and a possible extension of this direction of thought are finally suggested. (tr-auth)

34639 CORRELATION THEORY OF QUANTIZED ELECTROMAGNETIC FIELD. I. Horak, R. (Palacky Univ., Olomouc, Czech.). Czech. J. Phys., 19: 827-35(1969).

A correlation matrix is defined which describes arbitrary order correlation effects of the electromagnetic field. Dynamical equations are derived which govern the space-time development of the correlation matrix of the quantized electromagnetic field in vacuo. With the help of these equations, propagation laws and nonlinear conservation laws for the correlation matrix are obtained. (auth)

34640 GRADIENT TERMS IN COMMUTATORS OF CURRENTS AND FIELDS. Kaellen, G. (Univ. of Lund, Sweden). Acta Phys. Austr., Suppl. 5, 268-319(1968).

From 7th International Proceedings of Particles, Currents, Symmetries, Schladming, Austria. See CONF-680217.

Some elementary properties of the vacuum expectation value of a product of two vector fields (or currents) are reviewed. In particular, it is emphasized that the appearance or nonappearance of certain terms involving space derivatives of a δ-function in the equal time commutator between the time component and one space component of the field is not in contradiction with the canonical formalism when the coefficient in front of this gradient term is finite. When the coefficient involves a divergent integral as happens, e.g., in electrodynamics, a certain formal contradiction exists but is removed if the theory is considered as a consistent limit of a theory with a cut-off. For the particular case of electrodynamics it is further pointed out that the coefficient of the gradient term is related to the self mass of the photon which has to vanish in a consistent theory. (auth)

34641 ON FEYNMAN DIAGRAMS WITH INFINITE DIMENSIONAL REPRESENTATIONS OF THE LORENTZ GROUP O(3,1). Koller, K. (Imperial Coll. of Science and Tech., London). Acta Phys. Austr., Suppl. 5, 161-84(1968).

From 7th International Proceedings of Particles, Currents, Symmetries, Schladming, Austria. See CONF-680217.

A field theory with infinite-dimensional representations of the Lorentz group is considered. The mathematical structure of simple models is mainly considered. A derivation is given of the matrix elements of infinite-dimensional representations in an SU(2), SU(1,1) or Euclidean group U(1) Λ T(2) basis. The generated Dirac spinor wave functions are given by column of these infinite matrices. The relation between finite- and infinite-dimensional representations is shown, and it is emphasized that in many respects there should be a continuous transition between a field theory based on finite-dimensional representations to theories involving infinite-dimensional representations. The free local fields and free propagators for infinite-dimensional unitary fields are set up, and simple invariant three-point couplings among these are constructed, corresponding to the Feynman rules of local quantized field theory. Simple pole diagrams of the scattering amplitude are discussed. (J.F.P.)

34642 THE LEE MODEL WITH A SYMMETRY AND ITS RENORMALIZABILITY. Ataka, Yasusi (Univ. of Liverpool). Nucl. Phys., B10: 612-18(1969).

The Lee model with a "symmetry" condition $m_0 = m_N$, where m_0 is the bare V-particle mass, is investigated. The renormalization constant Z is always finite and lies between 1 and 0. No ghost appears. The divergences in the model are not removable by renormalization procedures. (auth)

34643 GOLDSTONE PARTICLES IN DE SITTER SPACE. Castell, L. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nuovo Cim., 61A: 585-92(June 21, 1969).

The framework of a field theory for scalar particles in de Sitter space is given. In the de Sitter space of negative curvature $-1/R^2$ causality can be defined in a similar way as in Minkowski space. In a quantum field theory the assumption of a degenerate vacuum leads to Goldstone particles, which have not mass m = 0, but mass m = 1/R. The parity of the Goldstone boson is -1, a result which does not follow necessarily in relativistic field theory. (auth)

34644 THE STRUCTURE OF THE EQUAL-TIME ANTI-COMMUTATOR OF THE BARYON CURRENT IN NEUTRAL PSEUDOSCALAR-MESON THEORY. Tapper, M. L. (Goddard Space Flight Center, Greenbelt, Md.). Nuovo Cim., 61A: 644-54(June 21, 1969).

The equal-time anticommutator of the baryon current h(x) which is the source term of the Dirac equation $(i\partial\!\!\!/ - m)\psi = ig\gamma_5 h(x)$ is studied for the case of a neutral-pseudoscalar-meson interaction. A method of calculating the equal-time anticommutator is given which incorporates the basic structure arising out of the Wilson hypothesis used to define the current. It is found that derivatives of $\delta^3(x - x')$ do not appear in the anticommutator. The absence of such Schwinger terms permits a theorem to be stated regarding the high-energy behavior of the spectral functions $\rho_1(M^2)$ and $\rho_2(M^2)$ which characterize the baryon propagator $S_F'(p)$. (auth)

34645 DAUGHTERS AND WEINBERG FIELD THEORY. Jenkins, J. D. (Imperial Coll. of Science and Tech., London). Nuovo Cim., 61A: 721-8(June 21, 1969).

A recurrence relation is obtained for the Feynman amplitude for the scattering of four spinless particles due to the exchange of a particle with spin J, described by a (J,0) field of Weinberg. It is shown that lower-spin contributions still occur in the amplitude, even though there are no redundant components in the spinor field. (auth)

34646 COVARIANCE IN QUANTUM FIELD THEORY. Takahashi, Y.; Shimodaira, H. (Univ. of Alberta, Edmonton). Nuovo Cim., 62A: 255-68(July 1, 1969).

The Poincaré commutators are used for the generators of the inhomogeneous Lorentz transformation to prove that the generators are unique when field operators are given and form an irreducible ring. It is further proved, under the assumptions (a) the vacuum is nondegenerate, (b) there is no massless particle, and (c) there exists the symmetric energy-momentum tensor, that only the generators from which the vacuum expectation value is subtracted satisfy the Poincaré commutators. The self-stress of a single particle is also discussed from the viewpoint of the Poincaré commutators, and the generalized Pais-Epstein formula of a single particle in motion is derived in a simple manner. (auth)

34647 CONSISTENCY OF CANONICAL COMMUTATION RELATIONS FOR THEORIES INVOLVING CURRENTS. Yodzis, P.; Ingraham, R. L. (New Mexico State Univ., Las Cruces). Nuovo Cim., 62A: 232-46(July 1, 1969).

It is shown that the well-known ambiguities associated with the application of canonical equal-time commutation relations to theories involving local currents can be eliminated by a generalization of Lorentz invariance previously suggested in connection with "stochastic" field theory. In particular, it is demonstrated that (1) there are no Schwinger terms in the commutators of stochastic currents, and (2) a stochastic current can commute with the fields with which it interacts. Some remarks are made on the relevance of these results to particle physics. (auth)

34648 LONG-RANGE SELF-INTERACTION OF THE GAUGE FIELD. Uzes, C. A. (Univ. of Georgia, Athens). Nuovo Cim., 62A: 157-73(July 1, 1969).

For localized non-Abelian gauge fields with positive definite energy density only the Yang–Mills current leads to nonvanishing internal charges on the classical level. The concept of a particle-like blob of gauge-field energy density is used in conjunction with a solution to the free Yang–Mills field equation at a fixed instant of time to investigate the long-range interaction of the charge-bearing field. If each blob carries only one kind of internal charge, this interaction is consistent with classical electrodynamics, supporting an asymptotic identification for the electrodynamic part of the gauge field. It is conjectured that non-Abelian gauge theory could lead to a relation between the strengths of the electromagnetic- and strong-interaction coupling constants. If the gauge field

carries more than one kind of internal charge, the presence of an additional interaction not observed in experiment is indicated. It is concluded that the non-Abelian gauge field should carry only one kind of internal charge, the electric charge. (auth)

34649 HIGH-ENERGY BEHAVIOUR OF FEYNMAN DIAGRAMS VIA THE ELECTRIC-CIRCUIT ANALOGY. Lam, C. S. (McGill Univ., Montreal). Nuovo Cim., 62A: 97-112(July 1, 1969).

Electrical-network analogy of Feynman diagrams is used to systematically derive high-energy behavior of scattering diagrams. Only two-body scalar diagrams are considered in detail, although the applicability of the method to more general cases is briefly touched upon. The result may be considered as an extension of Tiktopoulos' rule to general nonplanar diagrams. (auth)

34650 FIELDS AND PARTICLES. FIELD THEORY AND DISPERSION RELATIONS. Nishijima, K. Lecture Notes and Supplements in Physics. New York, W. A. Benjamin, Inc., 1969. 473p. $20.00 clothbound; $6.95 paperbound.

The basic concepts and techniques of quantum field theory are treated. The three approaches to quantum field theory—Feynman's method, canonical field theory, and dispersion theory—are shown to be complementary rather than contradictory. Emphasis is placed on the most typical problems encountered in field theory, and an unusually detailed explanation of the calculations used is offered. The topics covered include canonical quantization of fields, quantization of free fields, quantization of interacting fields, covariant perturbation theory, renormalization, Green's function and bound states, and dispersion theory. (L.B.S.)

Gravitation and General Relativity

34651 THIN CYLINDRICAL SHELLS IN GENERAL RELATIVITY. Langer, J. (Charles Univ., Prague). Czech. J. Phys., 19: 807-20(1969).

The sources of static cylindrically symmetric fields in the form of thin cylindrical shells are studied. The results are compared (in the case of the thin shell consisting of orbiting particles with the result of Raychaudhuri and Som). A special solution is also found, represented by a collapsing shell which is the source of the static field. (auth)

34652 USE OF A CONFORM METRIC FOR THE INTERPRETATION OF GENERAL RELATIVITY EQUATIONS IN THE LABORATORY. Juan, Henri (Faculte des Sciences, Marseille). Compt. Rend., Ser. A, 268: 919-22(Apr. 21, 1969). (In French).

Previous results are considered in the particular case of four-dimensional space-time U. These results transposed in a conform metric with the initial metric on the space U, permit several physical conclusions. (tr-auth)

34653 PROPERTIES OF INFINITESIMAL LORENTZ TRANSFORMATIONS IN A GRAVITATIONAL FIELD. Ivanitskaya, O. S. (Inst. of Physics, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk, No. 4, 85-91(1968). (In Russian).

The properties of the parameters of infinitesimal Lorentz transformations in a gravitational field in relation to the four vector gauge are established. Examples of simple, nonsimple, and zero parameters are given, in particular, for Schwarzschild fields of gravity. The possibility of simplification of the Einstein gravitational equation in tetrad form upon transformation to canonical parameters and the possibility of transformation to vector parameters in the Lorentz transformations are indicated. (tr-auth)

34654 FIELD THEORY OF GRAVITATION. Thirring, W. (Univ., Vienna). Acta Phys. Austr., Suppl. 5, 391-406(1968).

From 7th International Proceedings of Particles, Currents, Symmetries, Schladming, Austria. See CONF-680217.

A consequence of the universality of gravitation is discussed which determines the geometry of space-time. The Dicke-Eötvös experiment is considered. Gravitational theories which are built according to the pattern of electrodynamics are discussed. (J.F.P.)

34655 GAUGE PROPERTIES OF THE MINKOWSKI SPACE. Kastrup, H. A. (Univ., Munich). Acta Phys. Austr., Suppl. 5, 452-68(1968).

From 7th International Proceedings of Particles, Currents, Symmetries, Schladming, Austria. See CONF-680217.

The existence of useful gauge groups, which transform the coordinates $x = (x^0, \vec{x})$ of the Minkowski space, is considered. The classical free relativistic particle, geometrical interpretation, and the nonrelativistic case are discussed. (J.F.P.)

34656 SOME PROPERTIES OF EINSTEIN-MAXWELL FIELDS. II. SPECIAL CASES. Nagaraj, Muppinaiya (Bangalore Univ., India). Tensor, 18: 119-29(1967).

Various special cases which arise in the study of Einstein-Maxwell fields are discussed. These properties are considered with reference to the admissible Weierstrass characteristics of the contracted curvature tensor. (J.F.P.)

34657 EQUATIONS OF MOTION AND THE STRUCTURE OF SINGULARITIES. Newman, E. T.; Posadas, R. (Univ. of Pittsburgh). Phys. Rev. Lett., 22: 1196-8(June 2, 1969).

A new approach to equations of motion in general relativity is presented, in which matter is treated as singularities, of a particular kind, in the Weyl tensor. The motion of these singularities is defined in terms of their own surrounding space. The equations of motion then follow uniquely from the Einstein field equations. A concomitant result is the existence of internal structure for the singularities and equations of motion for this structure. (auth)

34658 SOME PROPERTIES OF EINSTEIN-MAXWELL FIELDS. I. Nagaraj, Muppinaiya (Bangalore Univ., India). Tensor, 18: 65-76(1967).

Some properties of Einstein-Maxwell fields are studied. These field equations are solved for the unknowns in the presence of charge, mass, and pressure (Poincaré), starting with the gravitational potentials as the given components of the metric tensor the four-dimensional Riemannian space-time. (J.F.P.)

34659 SCALAR DIFFERENTIAL INVARIANTS IN GENERAL RELATIVITY. Singh, K. P.; Sharan, R.; Singh, D. N. (Banaras Hindu Univ., India). Proc. Nat. Inst. Sci. India, Part A, 35: 94-102(Jan. 1969).

The fourteen scalar differential invariants of order two were evaluated for axially symmetric cylindrically symmetric and plane symmetric metrics, for the product of two surfaces metric and for the Gödel metric. It is found that a certain tensor vanishes for all the well-known line elements of gravitational significance. But it is nonzero for the most general orthogonal metric. Various scalar invariant relations are satisfied by the metrics of different symmetries. These relations serve as necessary conditions for a general Riemannian fourfold to represent the corresponding symmetry. (auth)

34660 INFLUENCE OF THE METRIC ON THE DEFINITION OF INERTIAL MASS IN RELATIVITY THEORY. Raab, Ivo (Univ., Innsbruck). Acta Phys. Aust., 28: 216-24(1968). (In German).

The general mass transformation formula is derived from the requirement that the mass and momentum conservation laws should hold in all coordinate systems, and linked with the metric fundamental tensor. It is shown that the mass no longer describes only a property of the body, but is tightly connected with the metric of the coordinate system. The deeper reason lies in the time gradient. Various special cases are discussed, and also the mass formula of general theory of relativity is easily regained. (auth)

Scattering Theory

Refer also to abstracts 34134 and 34645.

34661 (JINR-P2-4377) METHOD FOR FINDING THE FUNCTIONAL RELATIONS IN THE CHEW-LOW TYPE EQUATIONS. Meshcheryakov, V. A.; Rerikh, K. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1969. 17p. (In Russian). Dep.

A method is suggested for finding the functional relations between the matrix elements of S-matrix in the Chew-Low type equations. The method is formulated for equations with the 3×3 matrix of the crossing symmetry. This method is applied when finding the polynomial functional relations in the equations with A(1,1) matrix. Two functional relations are found. It is proved that other polynomial functional relations for A(1,1) do not exist. (auth)

34662 INTRODUCTION TO RECENT DEVELOPMENTS IN REGGE POLE THEORY. Dothan, Y. (Tel Aviv Univ., Ramat Aviv, Israel). Acta Phys. Austr., Suppl. 5, 126-60(1968).

From 7th International Proceedings of Particles, Currents, Symmetries, Schladming, Austria. See CONF-680217.

Recent developments in Regge pole theory are presented. Reggeization of helicity amplitudes and kinematical constraints, the Van Hove model for spinless external particles, and O(4) analysis in the equal mass case are covered. (J.F.P.)

34663 DOES THE VENEZIANO MODEL HAVE DUALITY. Lichtenberg, D. B.; Newton, R. G.; Predazzi, E. (Indiana Univ., Bloomington). Phys. Rev. Lett., 22: 1215-17(June 2, 1969).

It is shown that the Veneziano model can be cast into a form in which the leading asymptotic behavior at high energy in the direct channel comes from a term containing no direct-channel reso-

nances. The question of the meaning of duality under such circumstances is raised and discussed briefly. (auth)

34664 DIFFERENTIAL PROPERTIES OF FEYNMAN AMPLITUDES. II. Giffon, M. (Departement de Physique Nucleaire, Lyon). Nuovo Cim., 61A: 685-705(June 21, 1969).

The results previously obtained for the lower-order Feynman diagrams are generalized to the entire class of single-loop ones. The constraints introduced among all invariant variables in a production process, due to dimensionality of the physical space, are discussed. These constraints are expressed in a symmetric form. General reduction formulas are established for the amplitude and for the absorptive parts. Finally, the extension to a space with arbitrary dimensionality is discussed. (auth)

34665 PROOF OF THE MANDELSTAM REPRESENTATION FOR LOGARITHMICALLY SINGULAR POTENTIALS. Brander, O. (Chalmers Univ. of Tech., Goteborg). Nuovo Cim., 61A: 605-37(June 21, 1969).

The Mandelstam representation is proved in nonrelativistic potential-scattering theory for logarithmically singular potentials, that is potentials, analytic in Re $r > 0$, having a repulsive core of the form $V(r)|_{r\simeq 0} - r^{-2}$ ln r, and behaving at infinity like $V(r)|_{r\simeq\infty} Cr^{-\gamma} \exp[-\mu r]$, $\mu > 0$, $\gamma > 5/4$. The double spectral function is shown to be a continuous function for those γ. The proof rests on a detailed analysis, with a method developed by the author, of the partial-wave scattering amplitude for large energies and angular momenta. Using the thus obtained expressions for the partial-wave amplitude, the Martin proof of the Khuri dispersion relation, and the Bessis proof of the convergence of the double integral in the Mandelstam representation, are generalized to the case described above. (auth)

34666 SINGULARITIES OF THE DOUBLE SPECTRAL FUNCTION IN POTENTIAL SCATTERING THEORY. Brander, O. (Inst. of Theoretical Physics, Goteborg). Nuovo Cim., 61A: 638-43(June 21, 1969).

The double spectral function of the Mandelstam representation in nonrelativistic potential-scattering theory is analyzed with the method sketched by Bessis. It is shown that it may have singularities, connected in the following way to the behavior of the potential at infinity. For a potential satisfying $V(r)_{r\simeq\infty} r^{-\gamma} \exp[-\mu r]$, $\mu > 0$, $\gamma > 0$, the double spectral function is continuous for $\gamma > 5/4$, but has for $\gamma \leq 5/4$ singularities of the type $(t - 4\mu^2 - \mu^4/s)^{2\gamma - 3/2}\,\theta(t - 4\mu^2 - \mu^4/s)$, where $3/4 < \gamma \leq 5/4$, and $\delta(t - 4\mu^2 - \mu^4/s)$, when $\gamma = 3/4$. These singularities are integrable, and the Mandelstam representation is thus valid for $\gamma \geq 3/4$. For $\gamma < 3/4$ the singularities are nonintegrable, and the Mandelstam representation in its familiar form is not valid. As follows from the considerations of a preceding paper, the results are not changed by the introduction of a logarithmically singular repulsive core. (auth)

34667 A REMARK ON BOUND STATES IN POTENTIAL-SCATTERING THEORY. Ruelle, D. (Univ. of California, Irvine). Nuovo Cim., 61A: 655-62(June 21, 1969).

Let $H = H_B + H_C$ be the Hilbert space of an n-particle quantum system, where H_B is spanned by the bound states and H_C corresponds to the continuous spectrum of the Hamiltonian. It is shown that the wave functions which are in some sense localized in space and energy form a compact set in H. This is used to prove that a wave packet ψ remains localized at finite distance for all time if $\psi \in H_B$, and that it disappears at infinity if $\psi \in H_C$. (auth)

34668 DIFFERENTIAL PROPERTIES OF FEYNMAN AMPLITUDES. I. Giffon, M. (Departement de Physique Nucleaire, Lyon). Nuovo Cim., 61A: 663-84(June 21, 1969).

A method first proposed by de Alfaro, Jaksic and Regge to investigate the properties of Feynman amplitudes is developed; the lowest-order single-loop diagrams are discussed. In order to study the properties of the amplitudes a system of partial-differential equations in the invariant variables (masses and energies) is established. Besides from the analytic properties the number of independent analytic continuations of the amplitude and the relations existing among the absorptive parts are found. (auth)

34669 PADE APPROXIMANT AND THE JOST FUNCTION. Garibotti, C. R.; Villani, M. (Univ., Bari, Italy). Nuovo Cim., 61A: 747-54(June 21, 1969).

It is proved that for regular potentials the denominator of the [N,N] Padé approximate to the partial-wave scattering amplitude converges to the Jost function. (auth)

34670 A STABLE AND CONVERGENT EXTRAPOLATION PROCEDURE FOR THE SCATTERING AMPLITUDE. I. Ciulli, S. (CERN, Geneva). Nuovo Cim., 61A: 787-816(June 21, 1969).

The extrapolation of the amplitude out of its physical region being mathematically an "improper problem", it is not sufficient to have convergent expansions, one has to be also sure that the results are stable against small perturbations (experimental errors). This problem is solved by means of semi-convergent expansions in terms of conformal mappings of double connected domains. An optimization problem leads to an optimal mapping function, whose explicit form is then derived. The results can be used directly in the analysis of experimental data. (auth)

34671 A STABLE AND CONVERGENT EXTRAPOLATION PROCEDURE FOR THE SCATTERING AMPLITUDE. II. LEAST SQUARES AND INTERPOLATION IN ROOTS OF UNITY. Ciulli, S. (CERN, Geneva). Nuovo Cim., 62A: 301-18(July 1, 1969).

The extrapolation of the experimental data on scattering amplitude out of the physical region being a typical mathematical example of an "improperly posed problem" rapidly convergent expansions for the amplitude must be provided, and the results must be stable against small perturbations (experimental errors). A powerful extrapolation method in the form of an optimal conformal mapping was found in terms of which this problem was then solved by means of a limited-term (semi-convergent) expansion, whose coefficients were found by minimizing the maximum of the deviations in the physical region (Tchebycheff case). This analysis is extended to the physically important least squares and discrete-point interpolation cases. (auth)

34672 ON SOME PROPERTIES OF THE MULTI-PARTICLE AMPLITUDE EXPRESSED AS A FUNCTION OF GROUP-THEORETICAL VARIABLES. Toller, M. (CERN, Geneva). Nuovo Cim., 62A: 341-71(July 1, 1969).

A scattering process involving an arbitrary number of particles with arbitrary (not all vanishing) masses and arbitrary spins and parities is described in terms of amplitudes which are a generalization of the amplitudes introduced by Bali, Chew and Pignotti in their treatment of the multi-Regge model. The covariance properties of these functions are derived. It is proved that, if the boosts used in their definition are properly chosen in the complex Lorentz group, these amplitudes are free of kinematic singularities and constraints. The relevance of these results for the treatment of the kinematical details of the multi-Regge model is pointed out. (auth)

34673 EIGENFUNCTION EXPANSIONS ASSOCIATED WITH SCHROEDINGER TWO-PARTICLE OPERATORS. Bertero, M. (Univ., Genoa); Talenti, G.; Viano, G. A. Nuovo Cim., 62A: 27-87(July 1, 1969).

An expansion formula is proved, for any $f \in L^2(R^3)$, in terms of the eigenfunctions and of the scattering solutions associated with Schrödinger operators describing a system of two particles interacting through a local plus a nonlocal potential. The expansion formula can be applied to the investigation of the time-dependent scattering problem. (auth)

34674 SUM RULES FOR NONLOCAL POTENTIALS. Montes, A. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nuovo Cim., 62A: 144-56 (July 1, 1969).

Sum rules previously obtained for local potentials of finite range are demonstrated for nonlocal potentials of finite range. An estimate of the deviation from the sum rules for potentials decreasing exponentially at infinity is also considered. (auth)

34675 RELATIVISTIC EIKONAL EXPANSION. Abarbanel, Henry D. I. (Princeton Univ., N. J.); Itzykson, Claude. Contract AF 49(638)-1545. Phys. Rev. Lett., 23: 53-6(July 7, 1969).

A fully relativistic eikonal expansion is discussed. The connection with the high-energy behavior of elastic scattering, especially for quantum electrodynamics, is examined, and the relevance of the results for Regge asymptotic behavior is investigated. (auth)

Particle Accelerators

Refer also to abstracts 33359, 34264, 34564, and 34615.

34676 (BNL-13711) EXPERIMENTAL STUDY OF THE HORIZONTAL HALF INTEGRAL CORRECTIONS IN THE AGS. Herrera, J. C. (Brookhaven National Lab., Upton, N. Y.). May 15, 1969. 26p. Dep. CFSTI.

In the AGS there are a total of 24 quadrupoles, 12 located at each of the "17" straight sections where the horizontal beta function is a maximum, and 12 located at each of the "3" straight sections where the vertical beta function is a maximum. Normally, 4 of the horizontal quadrupoles at positions C-17, F-17, I-17 and L-17 are powered for approximately 25 msec during the early part of the acceleration cycle when the horizontal ν value of the particles passes through the critical value of $8\frac{1}{2}$. The theory of how such added perturbing gradients correct for the non-superperiod

symmetric gradient errors present in the machine has been discussed previously. The purpose of this experiment was to study the extent to which this theory was applicable to the actual AGS gradient corrections. It was found that the magnitude of the horizontal half integral corrections are consistent with the first order perturbation theory, and that the presence of terms which are of second order in the perturbing gradient does not influence the adjustment of these corrections. (W.H.K.)

34677 (CEA-CONF-1260) ACCELERATION OF HEAVY IONS IN A VARIABLE FREQUENCY CYCLOTRON AT SACLAY THROUGH USE OF A TROCHOIDAL INJECTOR. Knittner, G.; Maillard, R.; Papineau, A.; Poussard, H.; Re, C. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [1969]. 1p. (In French). (CONF-690314-2). Dep.

From Conference on the Physics and Production of Heavy Ions, La Plagne, France.

The heavy ion source at Saclay is of the large cathode surface arc type and will produce multicharged ions of Ne, O, N, C, and Li. The trochoidal apparatus for the injection of polarized protons is used for the injection of the heavy ions. In order to penetrate into the trochoidal injector, the ions are focused by a quadrupole and deflected to 45° by a magnet. This arrangement permits either heavy ions or polarized protons to be used in the cyclotron. The heavy ion beam can attain a maximum energy above 50 MeV. (J.S.R.)

34678 (CERN-69-13) THE SPARK-GAP SWITCHES OF THE NEW FAST BEAM EXTRACTION SYSTEM AT THE CERN PROTON SYNCHROTRON. Caris, L.; Williams, E. M. (European Organization for Nuclear Research, Geneva (Switzerland)). May 23, 1969. 39p. Dep.

A systematic study was made of the performance of the spark gaps in the course of 1 million operations. The pulse forms obtained with the front spark gap were found to contain some appreciable ripple, which is attributed to the rather open feature of the present design. The rise-time of the output pulse at 60 kV is around 20 nsec, but with decreasing voltage the rise-time deteriorates and at 33 kV it is around 40 nsec. In a clean condition the time jitter in the switching action is around ±2.5 nsec over the voltage range from 30 kV to 65 kV, with a corresponding delay in the switching action of about 43 nsec. With continued use the time jitter in the firing action becomes greater, and at the higher range of voltage it was found to remain stable at around ±6 nsec from 200,000 operations up to the maximum 1 million consecutive operations investigated in the present study. Towards the lower voltage range, the time jitter in the switching action after 1 million operations was found to be nearly 50% greater than the values found at high voltages, and a possible explanation for this behavior could be associated with a reduction in the photoelectric efficiency of cathode surfaces. The most troublesome aspect of the operation of the front spark gap was the tendency to premature firings, apparently concurring with the onset of an unstable behavior of the static breakdown characteristics towards the higher voltage range. There is evidence that suggests that these difficulties originate from a phenomenon occurring at the surface of insulators. The performance of the short-circuit spark gap was found to be quite satisfactory. The fall-time of the pulse is around 25 nsec over the voltage range from 30 kV to 65 kV. In a clean condition the time jitter in the switching action is ±3 nsec, and it increases to a level of about ±6 nsec after 1 million operations. These results were found to be applicable over the whole range of voltages investigated. (auth)

34679 (JINR-2351) ELECTROMAGNETIC FIELD OF CHARGED BEAM CONTAINED IN AXIMUTHAL-HOMOGENEOUS RING. Perel'shtein, E. A.; Yarkovoi, O. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1965. 16p. (In Russian). Dep.

The electromagnetic field and also the radiation field of a charged particle beam which was contained in an azimuthal-homogeneous ring are considered. The field was calculated in the second approximation according to the lag. This result is correct and is also related to the ultrarelativistic velocity of a particle along the beam. (tr-auth)

34680 (KFKI-5/1969) PULSED NEUTRON GENERATOR FOR REACTOR PHYSICS (NIG-200). Szabo, Z.; Dekany, I. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). 1969. 19p. Dep.

A pulsed D–T neutron generator developed and built for measurements in multiplying media is described. The pulse target current is 5 mA, the neutron yield during the pulse ~10^{11} n/s. The pulse length is variable from 10 μs to 1 ms, the repetition frequency from 0.1 to 2000 pps, the maximum duty cycle is 2%. The accelerating tube can be set to any position between the horizontal and vertical directions. The height of the rotational axis of the accelerating tube is variable from 0.90 m to 2.00 m above floor level. The 180 kV accelerating voltage is supplied by an insulating core transformer. (auth)

34681 (LA-4184) MEDIUM-ENERGY PHYSICS PROGRAM. Quarterly Status Report for the Period Ending April 30, 1969. (Los Alamos Scientific Lab., N. Mex.). May 29, 1969. Contract W-7405-eng-36. 40p. Dep. CFSTI.

Recent developments at LAMPF are discussed including developments in accelerator structures, rf power systems, accelerator control and instrumentation, accelerator physics, and the experimental area. (W.H.K.)

34682 (LNF-68/72) PROGRESS REPORT ON MAGNET OF THE TRANSVERSE AND LONGITUDINAL SOLENOID TYPE FOR EXPERIMENTS WITH ADONE. Note No. 421. Catitti, A.; Pasotti, G. (Comitato Nazionale per l'Energia Nuclear, Frascati (Italy). Laboratori Nazionali di Frascati). Dec. 12, 1968. 20p. (In Italian). Dep.

A study was made of a solenoid magnet to be mounted transversely and of one to be mounted longitudinally to the Adone beam for various experimental works. The principal characteristics of the two types of magnets with respect to the principal coil, the iron structure, and the compensating magnets are outlined. The possibility of reducing the encumberances of the compensators of the transverse solenoid is considered. (J.S.R.)

34683 (NP-17846) PROGRESS ON THE 80-GeV PROTON SYNCHROTRON. (Istituto Nazionale di Fisica Nucleare, Pisa (Italy)). Mar. 26, 1968. 357p. (In Italian). Dep.

An analysis is presented of the technical, financial, and time obligations necessary for the development of an 80-GeV proton synchrotron in Italy. The general characteristics of the accelerator and the general structure of the complex are outlined. The principal synchrotron is described. A fast cycle injector synchrotron and an injector synchrotron with multiple rings are also considered. The general controls of the synchrotron complex are discussed. The most efficient methods of developing p-p and p-$\bar{p}$ crossed beam storage rings are discussed. A new method of coherent acceleration proposed by Veksler (Smokotron) is considered in some detail. The electron cooling method of damping the betatron and synchrotron oscillations is discussed. (J.S.R.)

34684 (SLAC-PUB-543) ^{181}W CONTAMINATION INCIDENT. Busick, D.; Warren, G. (Stanford Linear Accelerator Center, Calif.). Jan. 1969. 9p. (CONF-690103-15). Dep. CFSTI.

From Health Physics Society Midyear Topical Symposium, Los Angeles, Calif.

A problem with radioactive contamination in the cooling water for a positron target in the Stanford Linear Accelerator is described. Insoluble materials containing tungsten-181, tungsten-185, and beryllium-7 were found inside the solenoid, including the coils and associated outlet cooling lines. (W.H.K.)

34685 (SLAC-PUB-563) RECENT BEAM PERFORMANCE AND DEVELOPMENTS AT SLAC. Helm, R. H.; Hogg, H. A.; Koontz, R. F.; Loew, G. A.; Miller, R. H.; Neal, R. B. (Stanford Linear Accelerator Center, Calif.). Mar. 1969. 5p. (CONF-690308-6). Dep. CFSTI.

From Particle Accelerator Conference, Washington, D. C.

The recent developments at SLAC which have contributed to improvements in beam operation are described. The overall beam performance and operational efficiency in delivering beams to various experiments are summarized. Specific developments such as the achievement of higher energies, increasingly narrow energy spectra, higher beam breakup current thresholds, chopped beams and improvements in pulse-to-pulse operation are discussed. A description of various new pulsed devices such as pulsed quadrupoles, improvements in the positron source and new beam loading measurements obtained for very short pulses is included. (auth)

34686 (UCRL-18596) SPACE CHARGE EFFECTS IN THE AXIAL INJECTION LINE FOR THE 88-INCH CYCLOTRON. Resmini, F.; Clark, D. J. (California Univ., Berkeley. Lawrence Radiation Lab.). May 1969. 13p. (CONF-690308-7). Dep. CFSTI.

From Particle Accelerator Conference, Washington, D. C.

Results of space charge calculations for higher beam intensities in the new axial injection beam transport line for the Berkeley 88-inch cyclotron are presented and discussed. (W.H.K.)

34687 (UCRL-18781) EXTRACTION AND TRANSFER OF HIGH-QUALITY BEAMS FROM SYNCHROTRONS OF THE FOOFDOD TYPE WITH APPLICATION TO THE OMNITRON. Meads, Philip F. Jr.; Selph, Frank B. (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1969. Contract W-7405-eng-48. 16p. (CONF-690308-5). Dep. CFSTI.

From Particle Accelerator Conference, Washington, D. C.

Acceleration of ions of low charge-to-mass ratio in the Omnitron is accomplished in two acceleration cycles with the beam transferred between the synchrotron and the concentric storage ring between cycles. Successful tandem acceleration requires that the beam quality be maintained through each ring-to-ring transfer. The extraction method described provides a ring-to-ring match in both betatron phase planes, including dispersion. Maximum efficiency is obtained from the deflecting magnets as a consequence of both kicking and extracting at the point of maximum radial betatron amplitude. The beam path and focusing are chosen to minimize the aberrations due to passing through the extreme fringing magnet in the accelerator gradient magnets. This requires a special focusing magnet in the accelerator extraction line and the shimming of two storage ring gradient magnets. (auth)

34688 (UCRL-Trans-1394) SYSTEM FOR ACCELERATING AN ION-LOADED ELECTRON RING. Bonch-Osmolvskii, A. G.; Dolbilov, G. V.; Kolpakov, A. O.; Kuznetsov, A. B.; Mamonov, V. N.; Reshetnikova, K. A.; Rubin, N. B.; Rubin, S. B.; Sarantsev, V. P. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by T. Watt for Univ. of California, Lawrence Radiation Lab., Berkeley, from report JINR-P9-4171. 28p. Dep. CFSTI.

An abstract of this paper, prepared from the original language, appeared as NSA 23: 13148. (B.G.D.)

34689 SYSTEM FOR TRACKING A SEPARATED BEAM OF SECONDARY PARTICLES. Korolev, V. A.; Trebukhovskii, Yu. V. (Inst. of Theoretical and Experimental Physics, Moscow). Prib. Tekh. Eksp., No. 2, 82-5(Mar.-Apr. 1969). (In Russian).

A system is described for tracking a separated beam, comprising two telescopes of scintillation detectors, an apparatus for remote transfer of the telescopes, a two-channel pulse number-to-amplitude converter, and a low-frequency oscillograph. (tr-auth)

34690 ONE-RESONATOR ACCELERATOR OF ELECTRONS. Kaminskaya, R. G.; Kaminskii, V. L.; Osipov, V. V.; Uralov, G. A.; Yushkov, Yu. G. (Tomsk Polytechnic Inst., USSR). Prib. Tekh. Eksp., No. 2, 23-4(Mar.-Apr. 1969). (In Russian).

A one-resonator accelerator of electrons with an energy of 0.8 MeV and an average current of 35 μA is described. The characteristics of the bundle at injection are given. It is shown that after a simple modification a current of 70 μA can be obtained. (tr-auth)

34691 DECREASE IN THE DIFFUSION RESISTANCE OF ACCELERATING TUBES WITH SMALL APERTURES. Tubaev, V. M.; Pivovar, L. I. (Physical-Technical Inst., Kharkov). Prib. Tekh. Eksp., No. 2, 25-6(Mar.-Apr. 1969). (In Russian).

The method for decreasing the diffusion resistance of accelerating tubes with a small diameter central channel and with auxiliary side openings for electrodes along the length of the tube was described. (tr-auth)

34692 LITHIUM ION SOURCE FOR CASCADE GENERATOR. Teplova, Ya. A.; Sukharevskii, V. G. (Inst. of Nuclear Physics, Moscow). Prib. Tekh. Eksp., No. 2, 27-8(Mar.-Apr. 1969). (In Russian).

An economical, small-dimension, simple lithium ion source for a cascade generator giving a current of 100 μA is described. (tr-auth)

34693 PRODUCTION OF THIN TARGETS FROM SEPARATED ISOTOPES. Sleptsov, G. N.; Solodovnikov, A. P. Prib. Tekh. Eksp., No. 2, 208-10(Mar.-Apr. 1969). (In Russian).

Methods are described for electrolytic deposition of layers of separated isotopes of nickel, copper, zinc, iron, and cobalt on gold supports with thicknesses of approximately 0.2 mg/cm^2 and for vacuum deposition on carbon semitransparent supports. The diameter of the targets was 24 mm. (tr-auth)

34694 INVESTIGATION OF BEAM BEHAVIOR IN A SECTOR CYCLOTRON. Matachun, A. T.; Gladyshev, V. A.; Katsaurov, L. N.; Moroz, E. M.; Nechaeva, L. P. Tr. Fiz. Inst., Akad. Nauk SSSR, 45: 7-14(1969). (In Russian).

The behavior of the particle beam in a sector cyclotron is studied using computer calculations. The harmonic analysis of the field for finding equilibrium orbits, the calculation of the betatron oscillation frequency, and an estimation of the trajectories in the presence of drift and other conditions are carried out. (tr-auth)

34695 DESIGN FEATURES OF 15 MeV ELECTRON LINAC FOR NONDESTRUGTIVE INSPECTION "MODEL ML-15R" AND FOR MEDICAL THERAPY "MODEL ML-15M". Gotoh, Masayuki; Fujita, Hyota (Mitsubishi Electric Corp., Amagasaki, Japan). Mitsubishi Denki Lab. Rep., 9: 221-52(Oct. 1968).

Electron linacs using 5 MW klystron have been developed for practical applications. In medical linacs, energy from 8 to 15 MeV, x-ray dose rate of 500 R/min at 1 m and electron dose rate of 1000 R/min at 1 m, are available. In radiography linacs, x-ray dose rate of 2000 R/min at 1 m at 12 MeV is available. The accelerated electron beam is focused by means of a pair of quadrupole magnets to be 2 mm in diameter and bombarded at the target to be converted into x-ray or passed through the window. In the radiography linac the design is aimed at stable high dose rate and small beam spot size. While in the medical linac, stable electron dose rate in the wide range of electron energy is especially considered. Stability of energy and dose rate, angular dependency of dose rate, and radiation characteristics are confirmed to show good performances. (auth) (NSA of Japan)

34696 VACUUM SYSTEM FOR HIGH-RADIATION ENVIRONMENT AT THE RPI LINAC LABORATORY. Haken, J.; Lewis, J. F.; Krasse, R. J. (Rensselaer Polytechnic Inst., Troy, N. Y.). Contract AT(30-3)-328. J. Vac. Sci. Technol., 6: 202-4(Jan.-Feb. 1969).

From 15th National Vacuum Symposium, Pittsburgh, Pa. See CONF-681012.

Vacuum system components on the RPL linear accelerator must operate in radiation fields averaging 5×10^5 rad/sec. Experience gained since the start of operations eight years ago indicates the special problems of constructing, maintaining, and modifying systems for high-radiation environments. (auth)

34697 STUDY OF A SOURCE OF HEAVY IONS WITHOUT ELECTRODE EXTRACTION. Mallen, C.; Taras, P. (Univ. of Montreal). Nucl. Instrum. Methods, 71: 333-8(1969). (In French).

An experimental study of the properties of an rf ion source which does not require an extraction electrode is described. The beam is extracted by means of a converging-diverging nozzle. The absence of any electrode drastically reduces the maintenance time required by the more common types of ion source. Beams of CO_2^+, O_2^+, O^+, N_2^+, and N^+ have been obtained with an intensity up to 150 μA for the N^+ ions when the optimum operating conditions of our present limited equipment are achieved. Suggestions for improving the intensity and the efficiency of the source are presented. The present system can also be used as a versatile gas target. (auth)

34698 A NEW WAY OF PRODUCING ION BEAMS FROM METALS AND GASES USING THE PLASMA JET FROM A DUOPLASMATRON. Masic, R.; Sautter, J. M.; Warnecke, R. J. (Compagnie Generale de Telegraphie sans Fil, Orsay, France). Nucl. Instrum. Methods, 71: 339-42(1969).

The principle and the construction of an ion source derived from a duoplasmatron are described. This source permits to obtain ions from solid and gaseous elements. mA beams of Li^+, O_2^+, Cu^+ have been extracted under 10 kV. (auth)

34699 DOUBLE SCATTERING ARRANGEMENT FOR THE PRODUCTION OF POLARIZED PROTONS. Deutscher, M.; Heinrich, G.; Hentschel, E. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Nucl. Instrum. Methods, 71: 301-10(1969).

A new type of double scattering arrangement for measurements of the angular distributions of the asymmetry in inelastic proton scattering is described. The conditions for a maximum intensity at a given energy spread are investigated. It can be shown that an optimizing procedure results in an increase of the intensity of two or three orders of magnitude compared with conventional double scattering arrangements. In the case of low energy proton scattering it is possible to limit the background in a suitable way. (auth)

34700 WAVEGUIDE COOLING SYSTEM FOR LINEAR ACCELERATOR. Gallagher, William J. (to Applied Radiation Corp.). U. S. Patent 3,449,618. June 10, 1969. Filed July 15, 1966.

A waveguide cooling system for linear accelerator utilizing a plurality of longitudinally extending passageways formed in the waveguide walls and interconnected by annular passageways surrounding the waveguide iris disks is described. (Offic. Gaz.)

34701 EFFECT OF TARGET SCATTERING ON THE SHIELDING OF HIGH ENERGY ELECTRON BEAMS. Jenkins, T. M.; Nelson, W. R. (Stanford Univ., Calif.). Health Phys., 17: 305-12(Aug. 1969).

Multiple scattering of high energy electrons is discussed with respect to the shielding of subsequently produced radiation. The shapes of the differential distributions as calculated from Fermi-Eyges theory and from Molière theory are presented. The integral distribution (i.e. the fraction of electrons that escape a cone of radius R) is calculated from both theories, adding a single scattering tail described by K/θ^4 to the Molière theory. The effects of finite beams on the scattering distribution are considered, and the

results from a 10 GeV positron scattering measurement are shown. (auth) (UK)

34702 MICROWAVE DEFLECTION SYSTEM FOR SUPERCONDUCTING PARTICLE SEPARATOR. Hahn, H.; Halama, H. J. (to United States Atomic Energy Commission). U. S. Patent 3,452,191. June 24, 1969.

This patent relates to a superconducting rf separator for charged particles traveling in a high energy beam wherein two deflector cells are provided having means for maintaining the desired phase shift and synchronization of each cell with the particles in the beam. (AEC)

34703 ENERGY SPECTRA OF CHARGED PARTICLES EMITTED BY A DUOPLASMATRON TYPE DISCHARGE. Gautherin, G.; Lejeune, C.; Prangere, F.; Septier, A. (CNRS, Orsay, France). Plasma Phys., 11: 397-410(May 1969). (In French).

Two experimental devices for energy analysis of charged particles — ions and electrons — emitted from a duoplasmatron type source are described. The energy spectra and their evolution as a function of various discharge parameters give information about the potential distribution along the discharge axis. Experiments to test the validity of the theory are analyzed and an elementary model which describes physical processes in a duoplasmatron type discharge is proposed. (auth) (UK)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 33472 and 34680.

34704 (GEPP-63) DESIGN AND EVALUATION OF A LABORATORY NEUTRON GENERATOR. Howell, J. F.; Pearson, A. W.; Wells, T. L. (General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.). Apr. 17, 1969. Contract AT(29-2)-656. 37p. Dep. CFSTI.

This report evaluates a compact laboratory neutron generator, which is a highly stable, long-life source of 14-MeV neutrons. This generator produces single, 10-microsecond bursts of neutrons, which are continually variable from 2×10^6 to 2×10^7 total neutrons per pulse. Shot-to-shot variability of the total neutron output per pulse is less than ±5 percent of the mean. The neutron waveshape remains approximately constant over the range of output. (auth)

34705 (IAE-1612) RELAXATION LENGTHS IN WATER. Abdullaev, Kh. Sh.; Nikitin, V. D.; Trukhanov, G. Ya. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). 1968. 20p. (In Russian). Dep.

The meaning of relaxation lengths which appear in various methods of solution of the transport equation is discussed. The relation between so-called relaxation length of the temperature of a neutron gas and the first relaxation length of neutron flow is deduced. Methods are proposed for obtaining the first relaxation length from the experimental space–energy distribution of thermal neutrons. These methods are used for the analysis of experiments in the graphite–water system with a temperature discontinuity at the interface between media. From the activation measurements the fundamental (~3 cm) and first (~0.46 cm) relaxation lengths in water are obtained. The value of the relaxation length obtained from the asymptotic part of the experimental distribution of the temperature of the neutron gas in water is ~0.27 cm. The question on the existence of the first discrete or quasidiscrete relaxation length in water is discussed. (auth)

34706 (IAE-1613) RETHERMALIZATION LENGTHS IN GRAPHITE AND IN WATER. Abdullaev, Kh. Sh.; Nikitin, V. D.; Trukhanov, G. Ya. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). 1968. 20p. (In Russian). Dep.

Methods for obtaining rethermalization lengths from the experimental space-energy distribution of thermal neutrons are developed. Using these methods, rethermalization lengths in graphite and water (graphite temperature 133 and 443°K, water temperature ~300 and 343°K) were calculated on the base of the experimental data for graphite–water system with a temperature discontinuity at the interface between the media. It was found that the rethermalization length in graphite depends slightly on the temperature of the neighbor zone and rather strongly depends on the graphite temperature (the latter phenomenon indicates that chemical bonds play a significant role in graphite at low temperature). The data are in good agreement with results of other authors. Rethermalization lengths in water obtained by different methods for a single experiment differ noticeably from each other, which shows nonuniversality of such neutron-physical characteristics of water as the rethermalization length. Comparison with other author's results is given. (auth)

34707 (N-69-14481) PREDICTIVE EQUATIONS FOR THERMAL NEUTRON FLUX PERTURBATION EFFECTS IN CYLINDERS. Lynch, John H.; Peters, Lawrence E. Jr. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Dec. 1968. 24p. (NASA-TN-D-4949). CFSTI.

The thermal neutron flux perturbation, depression, and self-shielding factors were measured for several cylinders having different materials and dimensions. The measurements were done for the high-flux test positions of the Plum Brook Reactor. Results of these measurements were fitted to polynomials that can be used by designers of irradiation experiments to predict flux perturbation effects in test specimens. The experiment design, results, and uncertainty are discussed. The behavior of the perturbation factor around the experiment design center is also examined. (auth) (STAR)

34708 EFFECTIVE-FIELD APPROXIMATIONS IN CLASSICAL LIQUIDS. Nelkin, Mark (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Phys. Rev., 183: 349-50 (July 5, 1969).

Three recent approximate theories of coherent scattering of slow neutrons in classical liquids are compared. Close connections are established among them which allow a considerable simplification in the computations needed to compare them with experiment. (auth)

34709 VALIDITY OF THE QUASICLASSICAL METHOD IN NEUTRON SCATTERING. Kaplan, David M.; Zweifel, P. F. (Virginia Polytechnic Inst., Blacksburg). Phys. Rev., 183: 310-12 (July 5, 1969).

The quasiclassical expression for the scattering of neutrons by an harmonic oscillator is compared with the exact result. One concludes that the quasiclassical method is valid for temperatures such that $\frac{1}{48}(\hbar\omega_0/kT)^2 \ll 1$ and momentum transfers $\hbar\kappa$ for which $\hbar^2\kappa^2/24m \ll 1$ (m = oscillator mass). Although these results are, strictly speaking, valid only for scattering by a single harmonic oscillator, it is felt that these conclusions are probably valid for scattering by any system if $\hbar\omega_0$ is replaced by the average level spacing. A simple proof of "Bloch's Theorem" is given. (auth)

34710 NUMERICAL RESULTS OF INTERFACIAL EFFECTS ON NEUTRON WAVES. Baldonado, O. C.; Erdmann, R. C. (Univ. of California, Los Angeles). Nucl. Sci. Eng., 37: 59-65 (July 1969).

The theory of neutron wave propagation through an interface is investigated with the following models: Model A—One-Speed Diffusion Theory, Model B—One-Speed Transport Theory, Model C—Energy-Dependent Diffusion Theory, and Model D—Energy-Dependent Transport Theory. Numerical results for these four models are given. The wave propagation constants α and β, where $k = \alpha + i\beta$, together with $\alpha^2 - \beta^2$ and $2\alpha\beta$ are compared. In addition, the energy-dependent phase shift $\theta(E,\omega)$ and amplitude $\rho(E,\omega)$ are also computed for Models C and D. The propagation constants compare well with one another. The differences between the four theories, although minor, are enhanced by comparing $\alpha^2 - \beta^2$ as a function of frequency. $\theta(E,\omega)$ and $\rho(E,\omega)$ are identical for Models C and D when plotted. A comparison of the discrete waves written in terms of incident, reflected, and transmitted components is also made. It is concluded that the continuum has a sizeable effect close to the interface. Energy and interface effects were seen to be separable from each other for the models studied. A comparison of the discrete amplitudes was made after neglecting continuum terms. The numerical results show that at the interface, the wave amplitude and phase shifts are almost identical for the two diffusion models but differ substantially from the transport models. (auth)

34711 THERMAL-NEUTRON DIFFUSION IN AQUEOUS ABSORBING SOLUTIONS. Goddard, A. J. H.; Johnson, P. W. (Imperial Coll. of Science and Tech., London). Nucl. Sci. Eng., 37: 127-36 (July 1969).

Thermal-neutron diffusion lengths were measured with an accuracy of typically ½% in aqueous absorbing solution contained in a tank adjacent to a reactor thermal column. Both pure water and boric acid solutions were used at 22.3 and 65°C, and solutions of cadmium and gadolinium salts at the lower temperature. Ten concentrations of each absorber were used. Two of the measured diffusion lengths for cadmium yield space eigenvalues which violate the $(\Sigma_T)_{min}$ limit of Corngold. Slight diffusion cooling occurs in cadmium solutions in contrast to marked heating effects in boron and gadolinium solutions. Theoretical predictions of diffusion lengths were obtained by a B_2 solution of the transport equation. Four scattering models were used: the Nelkin model, Haywood model, and two further models consisting of modifications to each of these. The modifications highlight particular parts of the hydrogen-atom generalized frequency distribution. A Laguerre polynomial expansion technique is investigated but found to be unsuitable for the analysis of non-1/v poison data. (auth)

34712 ANALYTICAL SOLUTIONS OF THE NEUTRON TRANSPORT EQUATION IN ARBITRARY CONVEX GEOMETRY. Gibbs, Alan G. (Battelle-Northwest, Richland, Wash.). J. Math. Phys. (N. Y.), 10: 875-90 (May 1969).

The integral equation describing the transport of monoenergetic, isotropically scattered neutrons in a one-, two-, or three-dimensional body of arbitrary convex shape, containing distributed sources, is considered. An exact representation of the neutron density $\rho(r)$ is obtained, involving a superposition of functions belonging to the null space of a simple differential operator. In general, when a countable basis is chosen to span the null space, the coefficients in the expansion of $\rho(r)$ satisfy a coupled system of singular integral equations which is reducible to a system of Fredholm equations. If no sources are present, an exact criticality condition is also obtained. Some techniques for evaluating the expan-

sion coefficients are given and several examples are considered. (auth)

34713 SLOW NEUTRON INELASTIC SCATTERING STUDY OF LIGHT WATER AND ICE. Harling, O. K. (Battelle-Northwest, Richland, Wash.). J. Chem. Phys., 50: 5279-96(June 15, 1969).

The results of an extensive slow neutron inelastic scattering study of H_2O at 268° and 299°K are reported. A high-energy resolution spectrometer was used to obtain the double differential scattering cross sections over a wide range of energy and momentum transfers. Energy transfers to 0.6 eV and momentum wave-vector transfers ($k = \Delta P/\hbar$) to 32 $Å^{-1}$ were measured for the liquid and solid phases of H_2O. The differential cross sections exhibit considerable structure corresponding to hindered rotational motions of the H_2O molecule as well as the intramolecular bending and stretching modes of vibration. In the case of ice the angular dependence of the scattering under the hindered rotation band is in good first-order agreement with the distribution calculated for a proton assumed to be bound in an isotropic elastic force field. The scattering properties of water and ice are presented in terms of the scattering law. In the latter form the results are compared to the calculated scattering using the McMurry–Russell modification of the Nelkin model, and the Egelstaff–Schofield theory for an incoherent scatterer with a Gaussian self-correlation function. Spectral densities for the modes of H_2O, in water and ice, have been obtained and used with program LEAP to regenerate scattering functions, which are in good agreement with the experimental results. The rms amplitude of the proton motions has been obtained from the spectral density. (auth)

34714 BEAM CENTERING IN A NEUTRON GENERATOR. Kosta, L.; Cvelbar, F.; Ramsak, V. (Nuclear Inst. Jozef Stefan, Ljubljana, Yugoslavia. Univ., Ljubljana, Yugoslavia). Anal. Chim. Acta, 45: 539-41(May 1969).

The use of photographic paper with a tritium (d,n) neutron generator to quickly give a picture of the configuration of the beam flux and density at any cross-section in the irradiation field is described. (W.H.K.)

Nuclear Properties and Reactions, A≤5

34715 (KFK-892) SINGLET AND TRIPLET FINAL STATE INTERACTION BETWEEN THE NEUTRON AND PROTON IN THE $^1H(d,2p)n$ REACTION. Brueckmann, H.; Gehrke, W.; Kluge, W.; Matthaey, H.; Schaenzler, L.; Wick, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Nov. 1968. 12p. (In German). (CONF-680461-1). Dep.

From Professional Commission on Nuclear Physics, Bad Neuenahr, Germany.

The three-particle reaction $^1H(d,2p)n$ was studied with 51.5-MeV deuterons from the Karlsruhe isochronous cyclotron. The two outgoing protons were detected in coincidence at laboratory angles $\theta_3 = +40°$ and $\theta_4 = 26°$. At these angles the final-state interaction between the neutron and one proton strongly influences the distribution of coincidences within the available phase space. The singlet and triplet final-state interaction between the neutron and proton is taken into account in an effective-range approximation. Using the Watson theory, a neutron–proton scattering length $a_{np} = (-21.4 \pm 1.5)$ fermi is derived. (auth)

34716 DEUTERON PHOTODISINTEGRATION AND MOMENTUM-DEPENDENT POTENTIALS. Kistler, S. (Univ., Cologne). Z. Phys., 223: 447-72(1969).

The influence of momentum-dependent potentials on the photodisintegration of the deuteron is investigated in order to study off-energy-shell effects. A general formula for the dipole sumrule and for the perturbation part of the Hamiltonian was derived. The integrated, total, and differential cross section is calculated with a special p^2-potential in the case of E1 + E2-transitions. Finally a family of momentum-dependent potentials, produced by isometric transformations, is considered and the effect of the nonlocal parts in the Hamiltonian is calculated for E1-transitions. The integrated and total cross section is obtained as a function of the parameters in the transformation. A geometrical explanation of the results is given. (auth)

Nuclear Properties and Reactions, 6≤A≤19

Refer also to abstracts 33485, 34541, 34737, 34813, and 34814.

34717 (ANL-7282, pp 34-41) GAMMA SPECTRA FROM DECAY OF RESIDUAL STATES FOLLOWING PHOTODISINTEGRATION OF ^{16}O. Baglin, J. E. E.; Owens, R. O. (Yale Univ., New Haven, Conn. Electron Accelerator Lab.).

The 5- to 6-MeV de-excitation γ rays for the $^{16}O(\gamma,p\gamma)$ and $(\gamma,n\gamma)$ reactions at 20- to 31-MeV bremsstrahlung energies were measured with a Ge(Li) detector. Cross sections for excited states in ^{15}N and ^{15}O were determined. (J.W.R.)

34718 (ANL-7282, pp 84-8) GAMMA-RAY SPECTRA FROM CAPTURE OF THERMAL NEUTRONS IN ^{10}B, ^{12}C, AND ^{13}C. Thomas, G. E.; Bollinger, L. M. (Argonne National Lab., Ill.).

The gamma spectra from thermal neutron capture in ^{10}B, ^{12}C, and ^{13}C were measured. (J.W.R.)

34719 (ANL-7282, pp 303-11) PRECISE MEASUREMENTS OF PRIMARY CAPTURE GAMMA-RAY ENERGIES USING A BOOTSTRAP METHOD. Greenwood, R. C. (Idaho Nuclear Corp., Idaho Falls).

A "bootstrap" method was used to measure primary capture γ rays in ^9Be, ^{23}Na, and ^{15}N. Neutron binding energies in ^{10}Be, ^{16}N, and ^{24}Na were determined from which the energies of the primary capture γ rays were precisely determined. (J.W.R.)

34720 (ANU-P-446) TENSOR POLARIZATION AND REACTIONS OF DEUTERONS ON ^{16}O AT BOMBARDING ENERGIES OF 4.4 TO 8.4 MeV. Cords, H.; Din, G. U.; Robson, B. A. (Australian National Univ., Canberra. Research School of Physical Sciences). [1969]. 38p. Dep.

The spin tensor moments $\langle T_{20}\rangle$, $\langle T_{21}\rangle$, and $\langle T_{22}\rangle$ of deuterons from ^{16}O–d elastic scattering were measured as a function of angle at an average deuteron bombarding energy of 6.34 MeV using the $^3He(d,p)^4He$ reaction as an analyzer. Absolute cross sections for the reactions $^{16}O(d,d)^{16}O$, $^{16}O(d,p)^{17}O$ (ground state and 0.871-MeV state), and $^{16}O(d,\alpha)^{14}N$ (ground state) were obtained as a function of angle at 5.755, 6.260, and 6.765 MeV and as a function of energy between 4.385 and 8.430 MeV for several angles. An analysis of these measurements was performed using the optical model and the distorted-wave and Hauser–Feshbach theories. (auth) (Australia)

34721 (N-69-12840) ELASTIC SCATTERING OF 21-MeV PROTONS FROM ^{14}N, ^{16}O, ^{40}Ar, ^{58}Ni, AND ^{116}Sn. Baron, Norton; Leonard, Regis F.; Lind, David A. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Dec. 1968. 26p. (NASA-TN-D-4932). CFSTI.

Differential cross section angular distributions were measured for 21-MeV incident protons elastically scattered from ^{14}N, ^{16}O, ^{40}A, ^{58}Ni, and ^{116}Sn. An optical model analysis was performed on these data and on previously measured elastic polarizations of 21 MeV incident protons scattered from the same nuclei. The optical potential used in this analysis included a real central term, a surface absorption term, and a real spin orbit term. Good fits to both the cross sections and polarizations for all nuclei except ^{16}O were obtained by allowing the nine parameters of the optical potential to vary from nucleus to nucleus. (auth) (STAR)

34722 TOTAL REACTION CROSS SECTION MEASUREMENTS WITH 60-MeV PROTONS. Menet, J. J. H.; Gross, E. E.; Malanify, J. J.; Zucker, A. (Oak Ridge National Lab., Tenn.). Phys. Rev. Lett., 22: 1128-31(May 26, 1969).

Total reaction cross sections for 60-MeV protons on ^{12}C, ^{27}Al, ^{56}Fe, ^{58}Ni, ^{59}Co, ^{60}Ni, ^{68}Zn, ^{90}Zr, ^{120}Sn, and ^{208}Pb were measured. Contrary to previous measurements, the results agree with predictions of the optical model. For a fixed-geometry potential the volume absorption term is reasonably constant with A, while the surface absorption term increases monotonically from 0.12 MeV for Al to 4.2 MeV for Pb. (auth)

34723 PRODUCTION OF ^{11}B AND ^{10}B BY PROTON SPALLATION OF ^{12}C. Davids, Cary N.; Laumer, Helmut; Austin, Sam M. (Michigan State Univ., East Lansing). Phys. Rev. Lett., 22: 1388-90(June 23, 1969).

Measurements of the ^{10}B and ^{11}B spallation production in ^{12}C are presented. These cross sections are related to theories on the origin of the elements lithium, beryllium, and boron. (auth)

34724 QUASI-FREE SCATTERING IN THE REACTION $^9Be(p,p\alpha)^5He$ AT 55 MeV. Yamashita, Sukeaki (Kyoto Univ.); Kakigi, Shigeru; Fujiwara, Noboru; (and others). J. Phys. Soc. Jap., 26: 1078-82(May 1969).

The reaction $^9Be(p,p\alpha)^5He_{g.s.}$ was studied by coincidence measurements of emitted protons and alpha particles. The angular correlation distributions were obtained in three manners. All of the distributions have a maximum at a pair of angles which corresponds kinematically to the zero momentum of the recoil nucleus. The yields at the recoilless angles are almost proportional to the differential cross section of the free proton–helium elastic

scattering at the corresponding angle. The absolute cross section and the width of the peak appeared in the angular correlation distribution are in fairly good agreement with the results given previously by the experiment on the reaction $^{9}Be(\alpha,2\alpha)^{5}He_{g'nd}$ at 28 MeV. (auth)

34725 PHENOMENOLOGICAL APPROACH TO FOUR-PARTICLE, FOUR-HOLE STATES IN ^{16}O. Das Gupta, S.; De Takacsy, N. (McGill Univ., Montreal). Phys. Rev. Lett., 22: 1194-6(June 2, 1969).

It is shown that a phenomenological approach to the four-particle, four-hole band in ^{16}O gives reliable predictions for the level spacings and the electromagnetic transition probabilities. (auth)

34726 MONOPOLE EXCITATIONS IN ^{16}O BY INELASTIC ELECTRON SCATTERING. Kaalhus, Olav (Univ. of Oslo). Nucl. Phys., A130: 146-54(1969).

The effects of deformed states on the inelastic electron scattering monopole form factors in ^{16}O are considered. The need of two different intrinsic two-particle–two-hole and four particle–four-hole components to describe the ground state of this nucleus is pointed out. Wave functions that meet this requirement are proposed. (auth)

34727 MUON-CAPTURE AND THE GROUND-STATE WAVE FUNCTION OF ^{16}O. Green, A. M. (Univ. of Helsinki. NORDITA, Copenhagen); Rho, M. Nucl. Phys., A130: 112-18(1969).

It is shown that the presence of two-particle–two-hole correlations in the ground state of ^{16}O brings theory into better agreement with the experimental values for the rates of the four transitions $\mu^- + {}^{16}O(g.s.) \rightarrow \nu_\mu + {}^{16}N(0^-, 1^-, 2^-, 3^-$ bound). (auth)

34728 RECOIL STUDY OF THE $^{12}C(p,pn)$ REACTION FROM THRESHOLD TO 150 MeV. Porile, N. T. (Purdue Univ., Lafayette, Ind.). Nucl. Phys., A130: 88-96(1969).

The average ranges projected in the forward, backward, and perpendicular directions were measured for ^{11}C from the $^{12}C(p,pn)$ reaction from threshold to 150 MeV. The results as well as similar data available for slightly higher energies are compared with a cascade-evaporation calculation based on the Vegas code. The calculation predicts ranges that are in fairly good agreement with experiment above 100 MeV, although the relative importance of the direct knock-out process appears to be underestimated. It is shown that compound nucleus formation is not the principal reaction mechanism below 50 MeV. (auth)

34729 RPA DESCRIPTION OF THE GROUND STATE OF ^{12}C, ^{16}O, ^{40}Ca, AND ^{208}Pb. Agassi, Dan; Gillet, Vincent; Lumbroso, Albert (Centre d'Etudes Nucleaires de Saclay, Gif-sur-Yvette, France). Nucl. Phys., A130: 129-45(1969).

The ground-state wave functions of ^{12}C, ^{16}O, ^{40}Ca, and ^{208}Pb are calculated within the framework of the random phase approximation to all orders in the number of excited particle-hole pairs. Large amounts of shell breaking are found; the probability for the double closed shell configuration is thus only 0.436 in ^{12}C, 0.665 in ^{16}O, 0.331, in ^{40}Ca and 0.555 in ^{208}Pb. Occupation numbers are small in ^{208}Pb ($\leq$0.08), moderate in ^{16}O and ^{40}Ca ($\approx$0.1), and large in ^{12}C ($\leq$0.26). An exactly soluble model shows that the RPA solution for such large-shell breaking still yields fairly accurate energies but underestimates the shell breaking. (auth)

34730 TRITON-INDUCED REACTIONS ON ^{12}C. Etoh, Kiichi (Nippon Atomic Industry Group Co., Kawasaki, Japan); Murata, Tohru; Kawai, Nawoyuki; Chiba, Ren; Takayanagi, Seiichi. J. Phys. Soc. Jap., 26: 1335-44(June 1969).

The excitation functions for the triton elastic scattering from ^{12}C and for the $^{12}C(t,\alpha_0)^{11}B$, $^{12}C(t,\alpha_1)^{11}B$, and $^{12}C(t,p_0)^{14}C$ reactions were measured at laboratory angles of 44.5°, 76°, 112.5°, 150°, 160°, and 165° in the range of triton energy from 0.6 to 3.4 MeV. The angular distributions of elastically scattered tritons and emitted α-particles were also measured at eighteen energies of the incident triton between 1.1 and 3.4 MeV. Prominent, broad maxima were observed in the excitation functions for the elastic scattering measured at backward angles in the region of 2.2 MeV. Twenty-one resonance-like peaks were found in the excitation functions of the reactions above described. An attempt was made to analyze the data on the elastic scattering using the optical model. (auth)

34731 ELASTIC AND INELASTIC SCATTERING OF 14.7 MeV DEUTERONS AND OF 29.4 MeV ALPHA-PARTICLES BY ^{6}Li AND ^{7}Li. Matsuki, S.; Yamashita, S.; Fukunaga, K.; Nguyen, D. C.; Fujiwara, N.; Yanabu, T. (Kyoto Univ.). J. Phys. Soc. Jap., 26: 1344-53(June 1969).

The angular distributions of alpha particles and deuterons scattered elastically and inelastically by ^{6}Li and ^{7}Li were measured. The 2.18-MeV state of ^{6}Li and the 0.478-MeV and the 4.63-MeV states of ^{7}Li were appreciably excited. The experimental angular distributions were analyzed with the DWBA theory, and the deformation parameters of the states were determined. Experimental results and the DWBA analysis show the existence of some difference between the inelastic scattering of alpha particles by ^{6}Li and by ^{7}Li, while no appreciable difference was observed in the case of the deuteron scattering. The DWBA calculation predicts larger quadrupole deformations of the excited states of ^{6}Li and ^{7}Li as compared with rotational model calculations of the energy levels. (auth)

34732 CROSS SECTION FOR THE REACTION $^{16}O(\gamma,n_0)^{15}O$ AT GIANT RESONANCE ENERGIES. Khan, T. A.; Hewitt, J. S.; McNeill, K. G. (Univ. of Toronto). Can. J. Phys., 47: 1037-46 (May 1, 1969).

The cross section for that photoneutron reaction in ^{16}O which leaves ^{15}O in its ground state was measured for photon energies ranging from 17 to 30 MeV, i.e., at energies corresponding to giant resonance excitations in ^{16}O. Time-of-flight methods, yielding resolutions equal to 100 keV at a neutron energy of 6 MeV, were used to measure neutron spectra emitted at an angle of 98° when targets of ordinary and heavy water were irradiated with pulsed bremsstrahlung. The differential cross section at 22.3 MeV excitation was found to be 1.00 ± .05 mb/sr, assuming a photodisintegration cross section at 98° equal to 55.3 μb/sr (laboratory system) for deuterium, this latter value having been derived from calculations which have been substantiated experimentally to within ±10%. The results are discussed with reference to other photodisintegration experiments and to recent theoretical work. (auth) (Canada)

Nuclear Properties and Reactions, 20 ≤ A ≤ 89

Refer also to abstracts 34491, 34492, 34719, 34721, 34722, 34729, 34734, 34814, and 34916–34918.

34733 (AD-681054) SCATTERING OF POSITRONS AND ELECTRONS BY NUCLEI. Lipkin, H. J. (Princeton Univ., N. J. Palmer Physical Lab.). July 1950. 79p. (TR-3). CFSTI.

The scattering at 57.9° of 1 MeV electrons and positrons by thin foils was investigated experimentally from two points of view: to compare the cross section for elastic nuclear scattering of positrons with that of electrons; and to look for inelastically scattered electrons which have suffered large energy losses. The first is of interest because theory predicts a large difference between positron and electron nuclear scattering resulting from spin-orbit coupling. The second is of interest because there have been many experimental reports of such inelastic scattering but no satisfactory theoretical reason for the effect. Values were obtained for the ratio of the electron scattering cross section to that of positrons at three different energies in the 1 MeV region for foils of platinum and copper. The results were in rough agreement with theoretical predictions, with a consistent deviation which may be attributed to the failure of the theory to include the effects of screening. The investigation of inelastic scattering failed to observe any effect in foils of aluminum, copper, platinum, and lead. (auth) (USGRDR)

34734 (ANL-7282) PROCEEDINGS OF THE CONFERENCE ON SLOW-NEUTRON-CAPTURE GAMMA-RAY SPECTROSCOPY HELD AT ARGONNE NATIONAL LABORATORY, 2-4 NOVEMBER 1966. Throw, F. E. (ed.) (Argonne National Lab., Ill.). Nov. 1968. Contract W-31-109-eng-38. 602p. (CONF-661113). Dep. CFSTI.

Separate abstracts were prepared for 44 of the 50 papers included. The remaining 6 papers have previously appeared in NSA as 21: 14458, 15606, 15607, 15608, 19470, and 26163. (J.W.R.)

For abstracts of individual papers see: 33382, 33472–33476, 34717–34719, 34735–34746, 34769–34783, 34802–34806, and 34916–34918.

34735 (ANL-7282, pp 14-18) GAMMA-RAY SPECTRA FROM RESONANCE NEUTRON CAPTURE USING A REACTOR BEAM. Martin, M. J.; Harvey, J. A.; Slaughter, G. G. (Oak Ridge National Lab., Tenn.).

Some measurements of gamma spectra from resonance neutron capture in aluminum, iron, and tin in a reactor spectrum are reported. Measurements were made with a Ge(Li) detector. (J.W.R.)

34736 (ANL-7282, pp 28-33) STUDY OF THE $^{59}Co(n,\gamma)^{60}Co$ REACTION. Shera, E. B. (Los Alamos Scientific Lab., N. Mex.).

The level structure of ^{60}Co was investigated through the $^{59}Co(n,\gamma)$ reaction. The low- and high-energy capture spectrum was mea-

sured and some coincidence data were also taken. Tentative spin-parity assignments were made for several levels in ^{60}Co. The experimental energy levels were compared with a zero-range central force calculation. (J.W.R.)

34737 (ANL-7282, pp 71-7) STUDY OF THE ^{19}F(n,γ)^{20}F REACTION. Blatchley, D. E.; Thomas, G. E. (Argonne National Lab., Ill.).

The de-excitation γ rays following thermal neutron capture in ^{19}F were investigated. Energies and intensities were measured for a number of transitions in ^{20}F. Tentative spin-parity assignments were made for the low-lying levels in ^{20}F. (J.W.R.)

34738 (ANL-7282, pp 286-9) γ−γ ANGULAR CORRELATIONS IN THE ^{51}V(n,γ)^{52}V REACTION. Carlos, P.; Samama, R.; Audias, A. (Commissariat a l'Energie Atomique, Saclay (France) Centre d'Etudes Nucleaires).

The γ−γ angular correlations in the ^{51}V(n,γ) reaction were measured. The asymmetries obtained were compared with theoretical calculations assuming pure E1 primary transitions and pure M1 secondary transitions. (J.W.R.)

34739 (ANL-7282, pp 312-18) GAMMA RAYS FROM THE ^{53}Cr(n,γ)^{54}Cr REACTION. Kane, W. R.; Mariscotti, M. A. (Brookhaven National Lab., Upton, N. Y.); Emery, G. T. (Indiana Univ., Bloomington).

The gamma rays from the ^{53}Cr(n,γ) reaction for thermal neutrons were measured for use as standards. The neutron separation energy of ^{54}Cr was determined as well as precise energies of several high-energy gamma rays. (J.W.R.)

34740 (ANL-7282, pp 319-25) A STUDY OF THE ^{28}Si(n,γ)^{29}Si AND ^{35}Cl(n,γ)^{36}Cl REACTIONS. Hughes, L. B.; Kennett, T. J.; Lycklama, H. (McMaster Univ., Hamilton (Ontario)).

Precise measurements of the γ-ray energies emitted in thermal neutron capture by ^{35}Cl and ^{28}Si were made using Ge(Li) detectors. Relative energies were determined in the high-energy (E_γ > 3 MeV) ends of the spectra and calibrated by the low-energy data. (J.W.R.)

34741 (ANL-7282, pp 326-33) PRECISION MEASUREMENTS OF STANDARD GAMMA-RAY ENERGIES. White, D. H.; Groves, D. J. (California Univ., Livermore. Lawrence Radiation Lab.).

A series of precision measurements of γ-ray energies using Ge(Li) detectors were performed by comparing escape-peak energies with well-measured secondary standard γ rays. The isotopes used were ^{28}Al, ^{41}Ar, ^{141}Ce, ^{60}Co, ^{51}Cr, ^{22}Na, ^{124}Sb, ^{52}V, ^{88}Y, and ^{69m}Zn. (J.W.R.)

34742 (ANL-7282, pp 375-80) ELECTROMAGNETIC TRANSITIONS IN ^{26}Mg. Carpenter, R. T.; Blatchley, D. E. (Iowa Univ., Iowa City. Argonne National Lab., Ill.).

The energies and relative intensities of γ rays corresponding to transitions in ^{26}Mg following neutron capture by ^{25}Mg were measured. Branching ratios for several levels were determined. (J.W.R.)

34743 (ANL-7282, pp 407-11) ENERGY LEVELS OF ^{46}Sc. Vervier, J.; Van Assche, P. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)).

The energy levels of ^{46}Sc were calculated in the framework of the shell model. A $1f_{\frac{7}{2}}$ orbit particle-hole configuration was assumed. The effective neutron-neutron interaction was deduced from data on ^{48}Ca and ^{46}Ca and the proton-neutron interaction from data on ^{42}Sc and ^{40}Sc. Spectroscopic factors and reduced M1 transition probabilities were obtained. (J.W.R.)

34744 (ANL-7282, pp 412-16) ENERGY LEVELS OF THE Co ISOTOPES. Vervier, J. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)).

The energy levels of ^{58}Co and ^{60}Co were calculated in the framework of the shell model. The orbits available for the proton hole and neutrons outside the Z = N = 28 closed shells were assumed to be $1f_{\frac{7}{2}}$ for the proton hole, and $2p_{\frac{3}{2}}$, $2p_{\frac{1}{2}}$, and $1f_{\frac{5}{2}}$ for the neutrons. A zero-range internucleon force was assumed whose parameters were determined from an analysis of the ^{58}Co levels. The results are compared with recent experimental data from stripping and pickup reactions. (J.W.R.)

34745 (ANL-7282, pp 483-91) COMPARISON OF THE γ-RAY SPECTRA PRODUCED BY 130-eV AND THERMAL NEUTRON CAPTURE IN Co. Wasson, O. A.; Bhat, M. R.; Chrien, R. E.; Lone, M. A.; Beer, M. (Brookhaven National Lab., Upton, N. Y.).

Gamma spectra from neutron capture by ^{59}Ce at thermal to 300 eV energies were studied to determine the interference between direct and resonance capture in the 132 eV state and to determine the direct-capture cross section for the ground-state transition. Direct evidence was found of a direct-capture component in the cross sections. (J.W.R.)

34746 (ANL-7282, pp 492-500) GAMMA-RAY SPECTRA OF ^{60}Co AND ^{56}Mn FOLLOWING RESONANCE CAPTURE IN ^{59}Co AND ^{55}Mn. Prestwich, W. V.; Cote, R. E. (Argonne National Lab., Ill.).

Gamma spectra and neutron time-of-flight spectra were studied for resonance capture in ^{59}Co and ^{55}Mn. Correlations were determined between the reduced widths and l_n values of final states. In the case of ^{60}Co, the correlation was taken as tentative evidence for direct capture. (J.W.R.)

34747 (ANU-P-447) ANGULAR CORRELATION STUDIES OF THE LOW-LYING LEVELS OF ^{29}Al. Kean, D. C.; Carter, K. W.; Piluso, C. J.; Spear, R. H. (Australian National Univ., Canberra. Research School of Physical Sciences). [1969]. 27p. Dep.

The 1.40, 1.76, 2.23, 2.87, 3.07, 3.19, and 3.44 MeV levels of ^{29}Al were studied via angular correlation measurements of the reaction ^{26}Mg(α,pγ)^{29}Al. Limitations are imposed on possible spins and on multipole mixing ratios of associated gamma-ray transitions. (auth) (Australia)

34748 THE (^{3}He,p) REACTIONS TO THE ANALOG STATES IN THE REGION OF N = 28. Shin, C.; Povh, B.; Schadewaldt, K.; Wurm, J. P. (Max-Planck-Institut fuer Kernphysik, Heidelberg Univ., Heidelberg). Phys. Rev. Lett., 22: 1124-7(May 26, 1969).

The (^{3}He,p) reactions on ^{46}Ti, ^{48}Ti, ^{52}Cr, ^{54}Fe, ^{56}Fe, ^{58}Ni, and ^{60}Ni leading to the 0^+ analog states were studied and compared with the (t,p) reactions on the same target nuclei and with the predictions of the pairing vibration model. (auth)

34749 THE DECAY OF ^{63}Zn. Borchert, Ingo (Univ., Goettingen, Ger.). Z. Phys., 223: 473-86(1969).

The decay of the 38.4-min-^{63}Zn was investigated using Ge(Li) counters and a Ge(Li)−NaI(Tl) coincidence circuit. Forty-three γ transitions in the energy range from 364.5 to 3100.9 keV were found, and their relative intensities were determined. A level scheme for ^{63}Zn → ^{63}Cu having 24 levels is proposed. This accounts for all observed γ transitions except one. (auth)

34750 NEGATIVE-PARITY STATES IN ^{42}Ca. Goode, Philip (Rutgers-The State Univ., New Brunswick, N. J.). Phys. Rev. Lett., 22: 1116-18(May 26, 1969).

A core-particle coupling-model calculation of the negative-parity levels in ^{42}Ca using random-phase-approximation states succeeds in explaining the strong fragmentation of the octupole strength in this nucleus relative to ^{40}Ca. The calculation also succeeds in producing the high density of odd-parity levels and their spectral positions but fails badly to account for the spectroscopic factors in the reaction ^{41}K(^{3}He,d)^{42}Ca. (auth)

34751 INTERNAL CONVERSION TABLES. PART III. COEFFICIENTS FOR THE ANALYSIS OF PENETRATION EFFECTS IN INTERNAL CONVERSION AND E0 INTERNAL CONVERSION. Hager, R. S.; Seltzer, E. C. (California Inst. of Tech., Pasadena). Nucl. Data, Sect. A, 6: 1-127(May 1969).

Coefficients for the analysis of penetration effects (nuclear-structure effects) are presented for internal-conversion coefficients and directional particle parameters. The coefficients are given for the four lowest electric and magnetic multipolarities in the K-shell and for the two lowest electric and magnetic multipolarities in the L- and M-shells. The coefficients are given for every fourth Z-value from 30 to 102 and for electron energies varying from 6 to 1500 keV above threshold. Some higher-order coefficients are given for E1 conversion. Coefficients for E0 internal conversion are included for the K- and L-shells, and values of the E0−E2 interference particle parameter are included for the K-shell. (auth)

34752 ANGULAR CORRELATION MEASUREMENTS IN ^{48}Ti. Monahan, C. F.; Main, I. G.; Nicholas, F. M.; Thomas, M. F.; Twin, P. J. (Univ. of Liverpool). Nucl. Phys., A130: 209-22 (1969).

States of ^{48}Ti, excited by inelastic proton scattering, were investigated using the particle−gamma ray angular correlation technique. States at 2.2947, 2.421, 3.377, and 3.631 MeV were shown to have spins 4, 2, 2, and 2 respectively; the correlations from the state at 3.868 MeV were consistent with an assignment of 3$^-$. A new level of spin (2,3) was shown to exist in the region of 3.23 MeV. Multipole mixing ratios were determined for the relevant gamma rays from all six states. Branching ratios were measured for the states at 2.421 and 3.868 MeV. (auth)

34753 ENERGY LEVELS IN ^{57,59,61}Co FROM THE ^{60,62,64}Ni(p,α) REACTIONS. Coop, K. L.; Graham, I. G.; Poate, J. M.; Titterton, E. W. (Australian National Univ., Canberra). Nucl. Phys., A130: 223-32(1969).

Enriched targets of ^{60,62,64}Ni were bombarded with protons of energies ranging from 9.5 to 10.5 MeV. Alpha particles populating levels in ^{57,59,61}Co were analyzed magnetically using a Buechner broad-range spectrograph with photographic-plate detection. Several new energy levels were found in ^{61}Co including the third

excited state which has been located at 1.287 MeV. Some nuclear systematics of the odd-mass cobalt isotopes are discussed. (auth)

34754 SHELL EFFECT ON THE ENERGY DEPENDENCE OF THE NUCLEAR LEVEL DENSITY. Maruyama, M. (Japan Atomic Energy Research Inst., Ibaraki). Nucl. Phys., A131: 145-68(1969).

The energy dependence of the nuclear level density of Ni, Cu, As, Br, Sr, Y, Nb, Sn, Sb, I, Cs, Ba, La, Ce, Pr, Ho, and Bi in the energy range 2 to 7.5 MeV was measured from inelastic neutron scattering. The observed level densities for the nuclei between the closed shells were well described by the Fermi gas model, and those for the nuclei at or near the shell closures were of non-Fermi gas form. The observed level densities of the above nuclei and of Co, Ag, In, Ta, and Au were compared with results obtained by a direct counting of the nuclear levels based on the shell model and the following results were obtained. The appearance of level density forms different from the Fermi gas form is explained by the existence of large energy gaps between the major shells in the single-particle level scheme. There is a fairly definite correlation between the level density form and the degree of shell filling in the nuclear ground state. (auth)

34755 SPIN INVESTIGATIONS OF EXCITED STATES OF ^{60}Co BY MEANS OF NUCLEAR ORIENTATION. Mellema, J.; Postma, H. (Kamerlingh Onnes Laboratorium, Leiden). Nucl. Phys., A130: 161-81(1969).

Nuclei of ^{59}Co were aligned in single crystals of cerium zinc (cobalt) double nitrate at about 0.018°K. The degree of orientation was determined with the 1.17- and 1.33-MeV gamma rays of ^{60}Co in a separate investigation. Gamma rays following thermal neutron capture in ^{59}Co were measured from aligned nuclei and from nuclei with isotropic spin distribution with a 6.4 cc Ge(Li) detector. Resulting anisotropies of gamma rays of high (5 to 7 MeV) and low (0 to 2 MeV) energies made it possible to assign spin values to several excited states of ^{60}Co. (auth)

34756 EXCITATION FUNCTIONS OF (n,p) AND (n,2n) REACTIONS FOR SOME ISOTOPES OF K, Mn, Zn, AND Cu. Bormann, M.; Lammers, B. (Univ., Hamburg). Nucl. Phys., A130: 195-208(1969).

The excitation functions of the (n,p) reactions for ^{41}K and ^{64}Zn and of the (n,2n) reactions for ^{55}Mn, ^{63}Cu, ^{65}Cu, ^{64}Zn and ^{66}Zn were measured in the energy region 13 to 18 MeV by the activation method. The experimental results are compared with statistical-theory predictions based on optical-model absorption cross sections and the Fermi gas model nuclear level density formula. Three different proposals to account for the pairing effect in the nuclear level density are compared. The dependence of (n,2n) cross sections on the neutron excess of the target nucleus is discussed. (auth)

34757 A Ge(Li)–Ge(Li) STUDY OF THE DECAY OF 2.4 h ^{66}Ge. Sarantites, D. G.; Gronemeyer, Suzanne (Washington Univ., St. Louis). Contracts AT(11-1)-1530; AT(11-1)-1760. Nucl. Phys., A130: 97-111(1969).

The level structure of ^{66}Ga was investigated from decay of the 2.4 h ^{66}Ge. From singles γ-ray energy and intensity measurements employing a high-resolution Ge(Li) detector, from coincidence relationships determined in $\gamma-\gamma$ coincidence measurements employing two Ge(Li) detectors, and from $\beta^+-\gamma$ coincidence measurements, it was established that levels at 43.5, 108.9, 233.9, 290.8, 381.7, 422.8, 514.3, 536.5, 706.3, and 866.1 keV are populated in the decay of 2.4 h ^{66}Ge. A possible level at 639.9 is also considered. From present log ft values and relative γ-ray intensities many J^π values were assigned. (auth)

34758 A STUDY OF THE ^{26}Mg(^{3}He,d)^{27}Al REACTION. Alford, W. Parker; Cline, D.; Gove, H. E.; Purser, K. H.; Skorka, S. (Univ. of Rochester, N. Y.). Nucl. Phys., A130: 119-28(1969).

Angular distributions of deuterons from the ^{26}Mg(^{3}He,d)^{27}Al reaction were analyzed with DWBA calculations to extract spectroscopic factors for most states in ^{27}Al up to 4.58-MeV excitation. Ground-state occupation numbers for $d_{\frac{5}{2}}$, $s_{\frac{1}{2}}$, and $d_{\frac{3}{2}}$ orbits in the ^{26}Mg ground state and the single-particle centroids in ^{27}Al are obtained. The results are in reasonable agreement with the excited-core model of the low-lying states of ^{27}Al. The negative-parity state at 4.05 MeV in ^{27}Al is shown to be a 1p hole state rather than a 2p particle state. Finally, a previous estimate of the excitation of $d_{\frac{3}{2}}$ particles in the ground state of ^{28}Si is shown to be questionable. (auth)

34759 THE REACTION ^{28}Si(^{3}He,α)^{27}Si AT E(^{3}He) = 12 MeV. Bray, K. H.; Nurzynski, J. (Australian National Univ., Canberra). Nucl. Phys., A130: 41-8(1969).

Angular distributions for the Si(^{3}He,^{3}He)Si and the ^{28}Si(^{3}He,α)^{27}Si reactions induced by 12-MeV ^{3}He particles were measured. The analysis in terms of the optical model and the DWBA was carried out, and the results are discussed in conjunction with other data for the neutron pick-up reactions from ^{28}Si. Occupation numbers for neutrons in $d_{\frac{5}{2}}$, $d_{\frac{3}{2}}$, and $s_{\frac{1}{2}}$ orbits are obtained for the ground state wave functions of ^{28}Si and compared with the proton occupation numbers. (auth)

34760 EVIDENCE FOR AN ENERGY LEVEL TRIPLET IN ^{56}Fe. Vaughan, K. (Simon Fraser Univ., Burnaby, B. C.); Pate, B. D.; Shapiro, M. H. Nucl. Phys., A130: 62-4(1969).

Evidence from radioactivity measurements and nuclear reaction studies is combined to establish the existence of three closely spaced levels in ^{56}Fe at 3117, 3119.3, and 3122.2 keV with J^π = (2^-), 1^+, and 4^+, respectively. (auth)

34761 TOTAL YIELD MEASUREMENTS IN ^{27}Al(p,γ)^{28}Si. Lyons, P. B.; Toevs, J. W.; Sargood, D. G. (California Inst. of Tech., Pasadena). Contract Nonr-220(47). Nucl. Phys., A130: 1-24(1969).

The reaction ^{27}Al(p,γ)^{28}Si was investigated in the proton energy range 0.3 to 2.6 MeV to obtain data needed for a calculation of the ^{28}Si photodisintegration rate in astrophysical situations. Total gamma-ray strengths were determined for 85 resonances. From 1.4 to 2.6 MeV a yield curve was measured, and an upper limit for the nonresonant cross section was determined. Where possible, resonance widths were deduced from the data. The gamma-ray detection efficiencies and target purity were investigated experimentally. Comparison was made with resonance strengths, measured by other methods, in the reactions ^{30}Si(p,γ)^{31}P and ^{26}Mg(p,γ)^{27}Al. (auth)

34762 TOTAL YIELD MEASUREMENTS IN ^{24}Mg(α,γ)^{28}Si. Lyons, P. B. (California Inst. of Tech., Pasadena). Contract Nonr-220(47). Nucl. Phys., A130: 25-30(1969).

The reaction ^{24}Mg(α,γ)^{28}Si was investigated for alpha-particle energies up to 2.8 MeV to obtain data needed for a calculation of the ^{28}Si photodisintegration rate in astrophysical situations. Total γ-ray strengths were determined for 16 resonances, including a previously unreported resonance at 1.358 ± 0.007 MeV. Photodisintegration rates for ^{28}Si through the p_0 and α_0 channels are given for temperatures from 1.5×10^9 to 5.0×10^9 °K. (auth)

34763 FURTHER EXPERIMENTAL EVIDENCE FOR COLLECTIVE EFFECTS IN ^{40}Ca. Anderson, R.; Robertson, A. G.; Start, D. F. H.; Carlson, L. E.; Grace, M. A. (Oxford Univ.). Nucl. Phys., A131: 113-36(1969).

Measurements of lifetimes, spins, and decay modes of levels in ^{40}Ca excited by inelastic proton scattering were made. The lifetimes were measured using the Doppler shift attenuation technique in a proton–gamma ray coincidence arrangement. The "level" at 6.03 MeV was found to be a doublet, with energies 6.026 and 6.030 MeV. Proton–gamma ray angular correlation measurements, in conjunction with the lifetime results, showed the spins to be 2^- and $(3^+,2^-)$, respectively. Similar measurements on the levels at 6.51 MeV and 6.54 MeV showed them both to be 4^+. The results of the lifetime measurements are as follows, 5.61 MeV (4^-), 950^{+280}_{-190} fsec: 5.63 MeV (2^+), 76 ± 21 fsec: 5.90 MeV (1^-), 60 ± 20 fsec: 6.026 MeV (2^-), 260 ± 30 fsec: 6.030 MeV $(3^+,2^-)$, 560 ± 190 fsec: 6.51 MeV (4^+), 160 ± 60 fsec: 6.54 MeV (4^+), 190 ± 60 fsec: 6.58 MeV (3^-), 250 ± 70 fsec. Mixing ratios are also reported: in particular the E2/M1 mixing ratio for the transition between the 2^+ states at 5.25 MeV and 3.90 MeV was found to be -13^{+3}_{-6}. Levels are identified with the rotational states predicted by Gerace and Green, and the measured E2 matrix elements, some of which are strongly enhanced, are found to be consistent with the model. (auth)

34764 INVESTIGATION OF THE ^{42}Ca(n,γ)^{43}Ca REACTION. Gruppelaar, H.; Op Den Kamp, A. M. F.; Spits, A. M. J. (Univ., Utrecht). Nucl. Phys., A131: 180-92(1969).

Gamma rays from thermal-neutron capture in enriched ^{42}Ca were investigated with Ge(Li) detectors. Gamma–gamma coincidence measurements were performed with a Ge(Li)–NaI detector combination. A decay scheme of ^{43}Ca was constructed containing 42 of the 47 observed γ-lines. The excitation energies of 16 levels of ^{43}Ca were determined with uncertainties of 0.2 to 1.1 keV. The ^{42}Ca(n,γ) reaction Q-value is Q = 7932.7 ± 0.5 keV. From the γ-decay, $J^\pi = \frac{3}{2}^-$ can be assigned to the l_n(d,p) = 1 level at E_x = 2046 keV. A strong correlation between the (n,γ) and (d,p) strengths was found. (auth)

34765 ENERGY LEVELS IN ^{47}Ti AND ^{50}V. Buhl, W. F. (Yale Univ., New Haven); Kovar, D.; Comfort, J. R.; Hansen, Ole; Pullen, D. J. Nucl. Phys., A131: 99-105(1969).

Energy levels in ^{47}Ti and ^{50}V were located by means of the ^{47}Ti(p,p'), ^{50}V(p,α), and ^{50}V(p,p') reactions. The (p,p') energy resolution was 8 keV, and the (p,α) resolution was about 15 keV. Fifty excited states were found in ^{47}Ti up to 3.84 MeV excitation,

and sixty excited ^{50}V states were identified below 3.75 MeV. Consistent level schemes are presented for both nuclei. (auth)

34766 EXCITATION ENERGIES OF LEVELS IN ^{34}S. Moss, C. E. (California Inst. of Tech., Pasadena. Triangle Universities Nuclear Lab., Durham, N. C.). Nucl. Phys., A131: 235-8(1969).

A sulfur target enriched in ^{34}S was bombarded with 6.5-MeV deuterons, and the emitted protons were observed with a magnetic spectrometer. The excitation energies of 37 levels in ^{34}S were determined, and the results are compared with previous results. (auth)

34767 A STUDY OF THE ^{23}Na(n,γ)^{24}Na AND ^{27}Al(n,γ)^{28}Al REACTIONS. Nichol, L. W.; Colenbrander, A. H.; Kenneth, T. J. (McMaster Univ., Hamilton, Ont.). Can. J. Phys., 47: 953-61 (May 1, 1969).

A study of the gamma radiation following thermal-neutron capture by natural sodium and aluminum was conducted using a Ge(Li) spectrometer. For sodium, 68 gamma rays were observed and their intensities and energies determined; for aluminum, 85 gamma rays were identified. A decay scheme for aluminum has been proposed from the present measurements. The neutron separation energies were found to be 6960.3 ± 1.5 keV for sodium and 7725.5 ± 1.5 keV for aluminum. The lifetime of the 472-keV level in sodium was measured to be 20.5 ± 0.5 ms using a chopped beam of neutrons. (auth) (Canada)

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Refer also to abstracts 34491, 34492, 34511, 34721, 34722, 34729, 34733, 34741, 34751, 34754, and 34799.

34768 (AERE-M-2199) ABUNDANCES OF LONG-LIVED DELAYED NEUTRON GROUPS ($t_{\frac{1}{2}}$ > 1 min) IN THE FISSION OF ^{235}U, ^{238}U, AND ^{239}Pu BY FISSION-SPECTRUM NEUTRONS. Tomlinson, L.; Hurdus, M. H. (Atomic Energy Research Establishment, Harwell (England)). Apr. 1969. 4p. Dep. CFSTI. UK 1s. 9d.

Upper limits are estimated for these abundances. The estimates are based on experimental measurements made on the thermal neutron fission of ^{235}U. (auth) (UK)

34769 (ANL-7282, pp 19-27) GAMMA RAYS FROM THE ^{189}Os(n,γ)^{190}Os REACTION. Mariscotti, M. A.; Kane, W. R. (Brookhaven National Lab., Upton, N. Y.); Emery, G. T. (Indiana Univ., Bloomington).

The level structure of ^{190}Os was investigated through ^{189}Os thermal neutron capture. Gamma singles and coincidence spectra were measured for several high-energy transitions in the (n,γ) reaction. Several new states were identified and spin-parity assignments were made. (J.W.R.)

34770 (ANL-7282, pp 62-70) LOW-LYING EXCITED STATES IN ^{108}Ag AND ^{110}Ag POPULATED BY PRIMARY THERMAL-CAPTURE GAMMA RAYS. Bolotin, H. H. (Argonne National Lab., Ill.).

The low-lying excited states in ^{108}Ag and ^{110}Ag were investigated through ^{107}Ag and ^{109}Ag thermal neutron capture. Gamma energies and intensities corresponding to a large number of states in ^{108}Ag and ^{110}Ag were measured. (J.W.R.)

34771 (ANL-7282, pp 78-83) GAMMA-RAY SPECTRUM FOLLOWING THERMAL-NEUTRON CAPTURE IN ^{166}Er. Prestwich, W. V.; Cote, R. E. (Argonne National Lab., Ill.).

The gamma-ray spectrum following thermal neutron capture in ^{166}Er was measured. The relative reduced partial widths for states in ^{167}Er were determined. (J.W.R.)

34772 (ANL-7282, pp 290-5) ANGULAR DISTRIBUTION MEASUREMENTS OF GAMMA RAYS FROM RESONANCE NEUTRON CAPTURE. Slaughter, G. G.; Martin, M. J.; Harvey, J. A. (Oak Ridge National Lab., Tenn.).

Relative neutron-capture γ-ray angular distributions were measured in the tin isotopes to determine the angular moments of the capturing states. Spectra were measured at resonance energies for ^{118}Sn, ^{122}Sn, and ^{124}Sn. Several transitions in ^{118}Sn + n were identified. (J.W.R.)

34773 (ANL-7282, pp 341-54) THERMAL-NEUTRON CAPTURE GAMMA-RAY STUDIES OF THE EXCITED STATES OF ODD-A HAFNIUM ISOTOPES. Bolotin, H. h.; Namenson, A. I. (Argonne National Lab., Ill.).

Gamma spectra were measured for the ^{178}Hf and ^{180}Hf (n,γ) reactions at thermal energies. A number of transitions in ^{179}Hf and ^{181}Hf were determined. The experimental data suggest that the statistical model may not be totally adequate to explain the character of the capture states. (J.W.R.)

34774 (ANL-7282, pp 355-74) RECENT COLLABORATIVE RESULTS ON NEUTRON CAPTURE IN ^{165}Ho. Motz, H. T. (Los Alamos Scientific Lab., N. Mex.).

Some studies on gamma and conversion-electron transitions in ^{166}Ho from thermal neutron capture in ^{165}Ho are summarized. (J.W.R.)

34775 (ANL-7282, pp 381-91) THE LEVEL SCHEME OF ^{114}Cd, BASED ON (n,γ) AND (d,p) EXPERIMENTS. Smither, R. K. (Argonne National Lab., Ill.).

The level scheme of ^{114}Cd was investigated up to 3 MeV excitation through (n,γ) and (d,p) reactions. Higher-order vibrational states were searched for. A number of levels up to 3 MeV were identified and J^{π} and l_n values determined. The results are compared with the phonon model. (J.W.R.)

34776 (ANL-7282, pp 398-405) 5-MeV GAMMA-RAY INTENSITY ANOMALY IN THE (d,pγ) REACTION. Earle, E. D.; Bartholomew, G. A.; Ferguson, A. J. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.); Bergqvist, I. (Forsvarets Forskningsanstalt, Stockholm (Sweden)).

A 12-MeV deuteron beam bombarded targets of ^{197}Au, Ir, ^{206}Pb, Pt, Re, ^{181}Ta, and Tl. The γ-p coincidence spectra were measured with NaI and Si(Li) detectors. An anomalous bump at about 5 MeV was seen in the gamma spectra for all the targets heavier than Ir. This bump is very similar to that seen in (n,γ) reactions with nuclei in the same mass region. (J.W.R.)

34777 (ANL-7282, pp 440-8) RESONANCE-NEUTRON CAPTURE GAMMA-RAY STUDIES AT THE MTR. Spencer, R. R.; Faler, K. T. (Idaho Nuclear Corp., Idaho Falls).

The facilities for resonance-neutron capture γ-ray studies at the Materials Testing Reactor are described. Some data on neutron capture in tungsten are reported. The high-energy γ spectra from the 4.1 and 7.6 eV resonances were measured. (J.W.R.)

34778 (ANL-7282, pp 459-72) RESONANCE (n,γ) SPECTRA IN TUNGSTEN ISOTOPES. Beer, M.; Bhat, M.; Chrien, R. E.; Lone, M. A.; Wasson, O. A. (Brookhaven National Lab., Upton, N. Y.).

The γ rays from resonance-energy neutron capture in the tungsten isotopes were studied. Gamma-ray events due to neutrons incident on a 30-mil-thick natural tungsten target were observed with Ge(Li) detectors and were according to the neutron time-of-flight and their γ-ray pulse heights. A number of levels in ^{183}W and ^{187}W are given. (J.W.R.)

34779 (ANL-7282, pp 473-82) GAMMA-RAY SPECTRA FOLLOWING NEUTRON CAPTURE IN RESONANCES OF ^{169}Tm. Lone, M. A.; Wasson, O. A.; Bhat, M. R.; Beer, M.; Chrien, R. E. (Brookhaven National Lab., Upton, N. Y.).

The γ-ray spectrum from neutron capture in ^{169}Tm at E_n = 1 to 100 eV was measured using a Ge(Li) detector. Spin assignments were made for several resonances which agree well with previous data. (J.W.R.)

34780 (ANL-7282, pp 501-6) THE ^{195}Pt(n,γ)^{196}Pt REACTION AS A ONE-CHANNEL PROCESS. Cote, R. E.; Prestwich, W. V. (Argonne National Lab., Ill.).

The γ spectra from the ^{195}Pt(n,γ) reaction for epithermal neutrons were analyzed for interference effects. Resonances were observed at 11.9, 19.6, and 67 eV. Interference patterns were seen in the 5998-, 6514-, and 7917-KeV transitions. (J.W.R.)

34781 (ANL-7282, pp 507-13) HIGH-RESOLUTION CAPTURE GAMMA-RAY MEASUREMENTS FROM THERMAL AND RESONANCE NEUTRON CAPTURE IN ^{115}Sn, ^{116}Sn, ^{122}Sn, AND ^{124}Sn. Harvey, J. A.; Martin, M. J.; Slaughter, G. G. (Oak Ridge National Lab., Tenn.).

The γ spectra from thermal and resonance neutron capture by ^{118}Sn, ^{119}Sn, ^{122}Sn, and ^{124}Sn were measured with Ge(Li) detectors. Most of the γ rays observed were fitted into the level schemes for ^{117}Sn, ^{120}Sn, ^{123}Sn, and ^{125}Sn. (J.W.R.)

34782 (ANL-7282, pp 514-22) RESULTS OF RESONANCE-NEUTRON CAPTURE STUDIES IN HAFNIUM. Faler, K. T.; Spencer, R. R. (Idaho Nuclear Corp., Idaho Falls).

Gamma spectra for capture of epithermal neutrons in natural hafnium were measured. Resonances corresponding to states in ^{178}Hf and ^{179}Hf were identified and assigned spins and parities. (J.W.R.)

34783 (ANL-7282, pp 523-31) MEASUREMENT OF RESONANCE-CAPTURE GAMMA-RAY SPECTRA WITH A 1/E NEUTRON SPECTRUM. Bollinger, L. M.; Thomas, G. E. (Argonne National Lab., Ill.).

The γ spectra from resonance neutron capture in ^{196}Pt and ^{182}W were studied. A 1/E neutron spectrum was used and average γ spectra resulting from capture in many resonances. This method

offers information on capture mechanisms as well as information on low-lying states. (J.W.R.)

34784 (APED-5398-A(Rev.)) SUMMARY OF FISSION PRODUCT YIELDS FOR ^{235}U, ^{238}U, ^{239}Pu, AND ^{241}Pu AT THERMAL, FISSION SPECTRUM AND 14 MeV NEUTRON ENERGIES. Meek, M. E.; Rider, B. F. (General Electric Co., Pleasanton, Calif. Nucleonics Lab.). Oct. 1, 1968. 62p.

A tabulation of experimental data, extrapolated chain yields, calculated charge distributions, and a recommended value for all known fission products is presented. The fissionable nuclides covered are ^{235}U at thermal, fission spectrum, and 14 MeV neutron energies; ^{238}U at fission spectrum and 14 MeV energies; ^{239}Pu at thermal and fission spectrum energies; and ^{241}Pu at thermal energies. (auth)

34785 (N-69-12778) EXCITED STATES OF ^{136}Ba AND ^{134}Ba. Julian, Glenn M.; Fessler, Theodore E. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Dec. 1968. 26p. (NASA-TN-D-4933). CFSTI.

Sources of 9.87-min ^{136}La and 6.82-min ^{134}La were made by bombarding enriched ^{136}Ba and ^{134}Ba with 10-MeV protons. A 20-cubic-centimeter lithium-drifted germanium detector was used to observe the γ rays emitted by ^{136}La and ^{134}La. The energies and relative intensities of these γ rays were measured. The results suggest the existence of excited states of ^{136}Ba at 818.5, 1578.9, 2080.2, 2128.5, 2141.0, and 2315.6 keV, and excited states of ^{134}Ba at 604.7, 1168.2, 2159.7, 2336.4, 2489.3, 2565.1, 2599.9, and 2693.3 keV. (auth) (STAR)

34786 (N-69-14482) SCATTERING OF 42-MeV (6.7pJ) ALPHA PARTICLES FROM EVEN ISOTOPES OF CADMIUM. SUPPLEMENT 1. ABSOLUTE CROSS SECTIONS. Baron, Norton; Leonard, Regis F.; Stewart, William M. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Dec. 1968. 14p. (NASA-TN-D-4948(Suppl.1)). CFSTI.

Measurements were performed to permit the determination of absolute cross sections for elastic and inelastic scattering of 42-MeV alpha particles from the even isotopes of cadmium. Previously reported measurements could not be converted to absolute cross sections because of the presence on the targets of a gold backing of unknown thickness. The thickness of the backing has been determined by measuring the yield of elastically scattered alpha particles from a gold foil of known thickness and comparing this yield with that observed from the gold backing during the cadmium experiment. Optical model and distorted-wave Born approximation calculations are carried out and compared with the absolute cross sections. (auth) (STAR)

34787 CORIOLIS INTERACTION BETWEEN THREE NILSSON BANDS IN Pa. Hoekstra W. (Univ. of Tech., Delft, Netherlands); Wapstra, A. H. Phys. Rev. Lett., 22: 859-60(Apr. 21, 1969).

By comparing new experimental results with calculations, it is shown that the levels above the $\frac{1}{2}^-$[5, 3, 0] ground-state band in ^{233}Pa and ^{231}Pa may be interpreted as resulting from the $\frac{1}{2}^+$[6, 6, 0], the $\frac{3}{2}^+$[6, 5, 1], and the $\frac{5}{2}^+$[6, 4, 2] bands involved in a three-band Coriolis interaction. (auth)

34788 THREE-QUASIPARTICLE MULTIPLET IN ^{139}Pr. McHarris, Wm. C. (Michigan State Univ., East Lansing); Beery, D. B.; Kelly, W. H. Phys. Rev. Lett., 22: 1191-4 (June 2, 1969).

^{139m}Nd in its ϵ decay preferentially populates a multiplet of six high-lying, high-spin, odd-parity states in ^{139}Pr. This is interpreted as $(\pi d_{\frac{5}{2}})^2(\nu d_{\frac{3}{2}})^{-2}(\nu h_{\frac{11}{2}})^{-1} \rightarrow (\pi d_{\frac{5}{2}})(\nu d_{\frac{3}{2}})^{-1} \times (\nu h_{\frac{11}{2}})^{-1}$, with the ^{139}Pr states being three-quasiparticle states. (auth)

34789 LOW-ENERGY THERMAL NEUTRON CAPTURE GAMMA-RAYS FROM Cd AND Sm. Sastry, D. L.; Parthasaradhi, K.; Jnanananda, S. (Andhra Univ., Waltair, India). Curr. Sci. (India), 38: 237-8(May 20, 1969).

The energies and intensities of the γ rays from the ^{113}Cd(n,γ) and ^{149}Sm(n,γ) reactions for thermal neutrons were measured with a single crystal scintillation spectrometer. (J.W.R.)

34790 GAMMA-GAMMA ANGULAR CORRELATIONS IN ^{147}Nd. Rajput, M. S.; Sehgal, M. L. (Aligarh Muslim Univ., India). Indian J. Phys., 42: 393-400(July 1968).

The angular correlation of three gamma-gamma cascades in the decay of ^{147}Nd to the levels of ^{147}Pm was studied. The measured angular correlation functions for these cascades are: $W(\theta, 91-91) = 1 + (0.058 \pm 0.029)\ P_2(\cos\theta) - (0.049 \pm 0.042)\ P_4(\cos\theta)$; $W(\theta, 442-91) = 1 + (0.053 \pm 0.012)\ P_2(\cos\theta) - (0.032 \pm 0.016)\ P_4(\cos\theta)$; and $W(\theta, 599-91) = 1 + (0.061 \pm 0.018)\ P_2(\cos\theta) - (0.052 \pm 0.022)\ P_4(\cos\theta)$. From the known log ft values of the beta transitions and the ground-state spin of ^{147}Pm the spins $\frac{3}{2}^+$, $\frac{5}{2}^+$, and $\frac{5}{2}^+$ were assigned to the levels at 182 keV, 533 keV, and 690 keV, respectively. From the graphical analysis of these functions, the multipole admixtures of the gamma rays are also determined. (auth)

34791 NEUTRON INELASTIC SCATTERING IN ^{206}Pb AND ^{207}Pb. Gupta, J. B.; Nath, N. (Univ. of Delhi). Indian J. Phys., 42: 408-13(July 1968).

Differential neutron inelastic scattering cross sections for individual states in ^{206}Pb and ^{207}Pb were calculated on the basis of the statistical theory of Hauser and Feshbach. Calculated excitation functions agree reasonably with experimental data for individual levels, except for the first excited state of ^{206}Pb. The agreement in general is closer at higher excitation energies as compared to the region nearer threshold. Factors likely to explain the lack of agreement observed are discussed. (auth)

34792 ALPHA DECAY AND THE STRUCTURE OF THE $K^\pi = 0^+$ STATES IN THE Th-U REGION. Cristu, M. I. (Inst. for Atomic Physics, Bucharest); Dumitrescu, O.; Pyatov, N. I.; Sandulescu, A. Nucl. Phys., A130: 31-40(1969).

The influence of the long-range effective forces on alpha decay to first $K^\pi = 0^+$ states of boundary nuclei ^{232}U, ^{230}Th, and ^{228}Th is analyzed. It is shown that only the model with pairing, quadrupole, and spin-quadrupole effective forces can describe both the energies and the alpha hindrance factors for β-states ($K^\pi = 0^+$) in this region. From the experimental data, the strength parameters for quadrupole and spin-quadrupole forces are determined. (auth)

34793 g-FACTORS OF THE 321 AND 463 keV LEVELS IN ^{125}Te. Singh, Vikram; Tandon, P. N.; Devare, S. H.; Devare, H. G. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., A131: 92-8(1969).

The g-factor of the 321-keV $\frac{9}{2}^-$ state of ^{125}Te was measured to be $g = -0.58 \pm 0.06$ from the rotation $\omega\tau$ of the angular correlation pattern of the 204.3-176.7 keV gamma ray cascade in externally applied fields of 12.6 and 19.5 kG. This value is very much higher than expected if this state were a three-quasiparticle $h_{\frac{11}{2}}$ intruder state as has been suggested recently by some workers. The present value indicates it to be of $(d_{\frac{3}{2}})^2_p(h_{\frac{11}{2}})^1_n$ character. For the 463-keV level, g-factor measurements were made using the large hyperfine fields present at the Te sites in iron. The 209-428 keV gamma-ray cascade was used and the value of the g-factor obtained is $g = -0.79 \pm 0.24$. This is quite close to the calculated value using wave functions given by Kisslinger and Sorensen for this state. (auth)

34794 REACTIONS OF ^{116}Cd WITH INTERMEDIATE ENERGY ^{3}He AND ^{4}He IONS. Montgomery, D. M.; Porile, N. T. (Purdue Univ., Lafayette, Ind.). Nucl. Phys., A130: 65-76 (1969).

Excitation functions and average range measurements are reported for the (α,αn), (^{3}He,α), (α,3n), and (^{3}He,2n) reactions of ^{116}Cd. Isomer ratios for reactions leading to ^{115m,g}Cd are also reported. The energies of the ^{3}He and ^{4}He ions varied between 13 and 33, and 18 and 45 MeV, respectively. The results of the average range measurements are compared with ranges predicted by Lindhard, Scharff, and Schiøtt on the assumption of compound nucleus formation. Good agreement is obtained for the (α,3n) and (^{3}He,2n) reactions at all energies, indicating the mechanism is predominantly compound nuclear. The average ranges for the products of the (α,αn) and (^{3}He,α) reactions are much lower than expected at energies greater than about 25 MeV. These results are interpreted as involving low momentum transfer due to a direct interaction mechanism. These conclusions are also corroborated by the isomer ratios. (auth)

34795 A THREE-QUASIPARTICLE ISOMERIC STATE IN ^{143}Sm. Neubert, W.; Alexander, K. F.; Rotter, H.; Chojnacki, S.; Droste, Ch.; Lewitowicz, J.; Morek, T. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys., A131: 225-34(1969).

In the reactions ^{128}Te(^{22}Ne,5n), ^{128}Te(^{22}Ne,7n), and ^{130}Te(^{20}Ne,7n), leading to ^{143}Sm, an isomeric state with $T_{\frac{1}{2}} = 30 \pm 3$ msec and an excitation energy of 2793 keV was found. In the decay of this state the following transitions were observed: 51 keV, 75 keV (M1, E1 + M2), 180 keV (E1), 209 keV (E3, isomeric transition), 1574 keV, 1703 keV and 1829 keV. As is confirmed by isomeric cross-section ratios, the decay leads to the first isomeric state at 755 keV. Probable spin and parity assignments for the new isomeric state are $\frac{19}{2}^+$ or $\frac{21}{2}^+$. (auth)

34796 ENERGY LEVELS OF ^{170}Lu. Treherne, J. (Institut de Physique Nucleare, Orsay, France); Vanhorenbeeck, J.; Valentin, J. Nucl. Phys., A131: 193-224(1969).

The energy levels of the odd nucleus ^{170}Lu, populated from the electron capture of ^{170}Hf (16.2 h), were examined with high-resolution 180° spectrographs, two iron-free double focusing spectrometers, silicon detectors, NaI crystals, and Ge(Li) detectors. Coincidence techniques were also used (γ-γ and e-γ). The level scheme is presented, and a tentative assignment of the spins is given in terms of the expected configurations. (auth)

34797 LEVELS OF ^{190}Os POPULATED BY ^{190}Ir. Yamazaki, T. (Tokyo Univ.); Ikegami, H.; Sakai, M. Nucl. Phys., A131: 169-79(1969).

Levels of ^{190}Os populated by ^{190}Ir were studied by means of a magnetic spectrometer, scintillation γ-ray spectrometers, and a Ge(Li) γ-ray spectrometer. Spin and parity assignments were made on the basis of internal conversion coefficients and $\gamma-\gamma$ angular correlations. (auth)

34798 LEVEL SCHEME OF ^{93}Zr. Arad, B.; Boulter, J.; Prestwich, W. V.; Fritze, K. (McMaster Univ., Hamilton, Ont.). Nucl. Phys., A131: 137-44(1969).

In order to confirm a prediction made by Talmi, the gamma rays following the beta decay of the 10.25 h fission product ^{93}Y were measured using a Ge(Li) spectrometer. In addition, the two-dimensional Ge–NaI coincidence spectrum was observed, and the level scheme of ^{93}Zr was derived. The level scheme of ^{93}Zr presented generally agrees with the level scheme derived by Knight et al., and with the levels obtained by Cohen and Chubinsky except for a few minor changes and a more exact energy determination. A level of 1167.7 keV was tentatively established, and it was suggested that this is the $9/2^+$ level predicted by Talmi. (auth)

34799 Ge(Li)–Ge(Li) GAMMA-RAY COINCIDENCE STUDIES OF THE DECAY OF 18.6h ^{159}Gd. Brown, R. A. (Univ. of Manitoba, Winnipeg); Roulston, K. I.; Ewan, G. T.; Andersson, G. I. Can. J. Phys., 47: 1017-27(May 1, 1969).

The gamma-ray spectrum of ^{159}Tb following the β decay of 18.6 h ^{159}Gd was studied with high resolution Ge(Li) detectors. Eighteen transitions were observed, two of which are reported here for the first time. The previously reported complex nature of the 617 keV transition was examined and high resolution studies have revealed a doublet structure with energies 616.5 ± 0.3 and 617.7 ± 0.2 keV and intensities of $(2.3 \pm 0.6) \times 10^{-3}$% and $(15.0 \pm 2.3) \times 10^{-3}$% per disintegration respectively. Gamma–gamma coincidence experiments were performed with large volume coaxial and thin window planar Ge(Li) detectors, using the related address technique and on-line computers. These experiments established levels at 58, 138, 348, 363, 581, 618, 674, and 855 keV. All of the transitions observed in the direct spectrum have been fitted into the level scheme. (auth) (Canada)

34800 RADIATIVE CAPTURE OF NEUTRONS BY THE 5.2 eV RESONANCE IN ^{109}Ag. Ing, H.; Gameson, J. J.; King, J. D.; Taylor, H. W. (Univ. of Toronto). Can. J. Phys., 47: 1133-42(May 15, 1969).

The reaction ^{109}Ag(n,γ)^{110}Ag was studied through the capture of neutrons by the 5.2 eV resonance in ^{109}Ag. The gamma rays were observed with a 33 cm^3 Ge(Li) detector and a 2048-channel pulse-height analyzer. A level diagram spanning the range 0–2 MeV is proposed for ^{110}Ag and compared with the level diagram based on the gamma transitions produced by capture of thermal neutrons. The distribution of partial radiative widths was obtained and was found to be in good agreement with the Porter–Thomas distribution. (auth) (Canada)

34801 ENERGY LEVELS OF ^{94}Mo EXCITED IN THE DECAY OF THE ^{94}Tc ISOMERIC PAIR. Barrette, J.; Boutard, A.; Monaro, S. (Univ. of Montreal). Can. J. Phys., 47: 995-1003 (May 1, 1969).

The γ-ray spectra resulting from the decay of the ^{94m,g}Tc isomeric pair to the excited states of ^{94}Mo were investigated using Ge(Li) solid state detectors. Gamma rays (relative intensities are in parentheses) of 871.05 (100); 993.19 (2.35); 1196.4 (0.80); 1522.1 (4.80); 1868.68 (6.10); 2393.2 (0.50); 2529.8 (0.33); 2740.1 (3.74); 3129.1 (1.47); 3512.5 (0.06); 3793.1 (0.05); 3892.7 (0.016); plus several other weak lines were observed in the decay of ^{94m}Tc (52 min). Gamma rays (relative intensities are in parentheses) of 449.2 (3.3); 532.1 (2.35); 702.67 (99.7); 742.3 (1.21); 849.74 (95.8); 871.05 (100); 961.10 (7.6); 1509.3 (0.68); 1592.1 (2.25); 1765.6 (0.29) were detected in the decay of ^{94g}Tc (5h). To investigate this latter activity a hollow coaxial Ge(Li) spectrometer was also used as a well-type detector in order to obtain sum spectra of coincident gamma rays. The overall results obtained from this study allow construction of a level scheme of ^{94}Mo which compares fairly well with previous investigations and removes some inconsistencies shown in Coulomb excitation measurements. (auth) (Canada)

Nuclear Theory

Refer also to abstracts 33405, 34546, 34634, and 34729.

34802 (ANL–7282, pp 210-17) MULTIPARAMETER DATA ACQUISITION AND ANALYSIS AT THE HFBR FAST CHOPPER. Bhat, M. R.; Soucek, Branko; Borrill, B. R.; Chrien, R. E.; Wasson, O. A. (Brookhaven National Lab., Upton, N. Y.).

A computer system for collecting data on neutron-capture γ-ray experiments at a fast-chopper facility is described. Details of the on-line data acquisition and off-line data analysis are discussed. (J.W.R.)

34803 (ANL–7282, pp 245-54) ANALYSIS OF NEUTRON CAPTURE GAMMA-RAY SPECTRA. Stevens, M. M.; Harvey, J. A. (Oak Ridge National Lab., Tenn.).

Neutron-capture γ spectra obtained with Ge(Li) detectors may show many peaks corresponding to discrete energy γ rays from the reaction. Energies and intensities of the γ rays must be determined to interpret the spectra and level structure of the compound nucleus. For high-energy γ rays it is often desirable to determine energy differences more accurately than absolute energies. A computer program was written for analysis of this kind of spectra. The program also gives more accurate results for complicated spectra in which the peaks are not resolved. (J.W.R.)

34804 (ANL–7282, pp 255-63) GAMMA-RAY SPECTRAL ANALYSIS. Bolotin, H. H. (Argonne National Lab., Ill.).

Methods were developed to obtain a high degree of accuracy in the analysis of neutron-capture γ spectra. A fitting technique employed to obtain accurate peak positions and the decomposition of complex pulse-height spectral regions is described. The use of these results to determine γ-ray energies with high accuracy is discussed. (J.W.R.)

34805 (ANL–7282, pp 265-78) INVESTIGATION OF CONVERSION-ELECTRON SPECTRA FOLLOWING NEUTRON CAPTURE. Bieber, E. (Argonne National Lab., Ill.).

The techniques used in studying prompt internal-conversion electrons from slow-neutron capture are described. The problems encountered in measuring internal conversion spectra are also discussed. The information that can be obtained from internal conversion spectra is described. (J.W.R.)

34806 (ANL–7282, pp 417-25) THEORY OF CAPTURE REACTIONS. Clement, C. F. (Florida State Univ., Tallahassee. Dept. of Physics).

The theory of neutron capture reactions in the resonant region and leading to low-lying final states is reviewed. (J.W.R.)

34807 (N–69-17976) HARTREE–FOCK CALCULATIONS WITH WOOD–SAXON BASIS FUNCTIONS. Ford, William F.; Braley, Richard C. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Feb. 1969. 25p. (NASA-TN-D–5066). CFSTI.

Hartree–Fock method is used to study the even-even N = Z nuclei in the 2s-1d shell. Basis functions with correct asymptotic behavior are generated by use of a Wood–Saxon well. The results are compared with calculations using the conventional harmonic oscillator basis. It is found that most of the Wood–Saxon results may be obtained with a harmonic oscillator basis if the oscillator parameter is carefully chosen. (auth) (STAR)

34808 (UCRL–18269) TABLES OF STRUCTURE AMPLITUDES FOR (p,^{3}He) REACTIONS. Glendenning, Norman K. (California Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1968. Contract W-7405-eng-48. 102p. Dep. CFSTI.

Tables are given which provide the projected wave function for the center-of-mass motion of a neutron–proton pair in a nucleus which occupies the single-particle states j and j′ with spin J, when their relative motion corresponds to that characteristic of what it is in the helium nucleus. (L.T.W.)

34809 SHELL MODEL FOR N = 82 NUCLEI. Wildenthal, B. H. (Texas A and M Univ., College Station). Phys. Rev. Lett., 22: 1118-20(May 26, 1969).

Initial results from a shell-model calculation of the energy levels of N = 82 nuclei are reported. Comparison of the theoretical spin and parity values and level structure of the N = 82 isotones with experiment indicates good agreement. (L.T.W.)

34810 PECULIARITIES OF THE PION–NUCLEAR INTERACTION. Ericson, M. (Massachusetts Inst. of Tech., Cambridge); Ericson, T.; Krell, M. Contract No. AT(30-1)-2098. Phys. Rev. Lett., 22: 1189-91(June 2, 1969).

It is argued that the observed attraction in π–nuclear interactions for $l \neq 0$ should become a repulsion for large nuclear radius. The critical radius depends on angular momentum. (auth)

34811 NONRELATIVISTIC TWO-NUCLEON POTENTIAL. Ulehla, I. (Charles Univ., Prague). Czech. J. Phys., 19: 553-71(1969).

One of the possible general representations of the nonrelativistic two-nucleon potential is given. The main part of the paper is devoted to the practical problem of computing the two-nucleon potential from the experimental data. (auth)

34812 APPLICABILITY OF THE ELASTIC APPROXIMATION UNDER CONSIDERATION OF THE INTERACTION IN THE INITIAL AND FINAL STATES. Orlov, Yu. V. Vestn. Mosk. Univ., Ser. III. Fiz. Astron., 24: 111-13(Jan.-Feb. 1969). (In Russian).

For the dispersion approach in considering the initial and final states in a direct nuclear reaction A + x → B + y, the conditions of the unitaryness of the S matrix are used. The term taking into account the bond between the channels in the formal solution is neglected in the final expression. The validity of the elastic approximation is indicated by the fact that the last term of the equation concerning the partial reaction amplitude may be indeed neglected. These relations were examined for the scattering of neutrons on the ^{12}C nucleus as a function of the orbital momentum for neutron energies ranging from 5 to 74 MeV. The case of (d,p) reaction has been studied by B. Buck and J. R. Rook who found that the elastic approximation may indeed work. As a general rule it is difficult to substantiate that the contribution of the inelastic channels may be neglected; this applies in particular to reactions in which the absorption in the initial and final channels differ strongly from each other. (TTT)

34813 ALPHA ELASTIC SCATTERING AT LARGE ANGLES WITH THE AID OF NONLOCAL SEPARABLE POTENTIALS. Pigeon, J.; Barguil, J.; El Baz, E. (Univ., Lyon). Nucl. Phys., A130: 49-61(1969). (In French).

The use of separable nonlocal potentials allows an exact calculation of the elastic scattering amplitude with only two terms in the Born expansion. The calculation is performed for elastic scattering of α particles on ^{12}C and ^{16}O at about 20 MeV. At backward angles where the Coulomb effect is negligible, the fit obtained is very good with only two parameters and without any normalization. (auth)

34814 CORRECTIONS TO THE ft-VALUES OF $0^+ \rightarrow 0^+$ SUPERALLOWED β-DECAYS. Damgaard, J. (California Inst. of Tech., Pasadena). Contract AT(04-3)-63. Nucl. Phys., A130: 233-40(1969).

The second-forbidden corrections to superallowed Fermi β-decays are determined by expectation values rather than matrix elements between states of different structure. They partly cancel the corrections arising from violation of isospin symmetry. Within the limits of experimental uncertainty, $(ft)_{corr}$ has the same value for all the decays except that of ^{26}Al. (auth)

34815 MICROSCOPIC CALCULATIONS OF THE INERTIAL MASS PARAMETER FOR FISSIONING NUCLEI. Sobiczewski, Adam (Inst. for Nuclear Research, Warsaw. Univ. of Warsaw); Szymanski, Zdzislaw; Wycech, Slawomir; Nilsson, Sven Goesta; Nix, James Rayford; Tsang, Chin Fu; Gustafson, Christer; Moeller, Peter; Nilsson, Bjoern. Nucl. Phys., A131: 67-91(1969).

Inertia mass parameter B in a fissioning nucleus is calculated. The method of calculation is based on the assumption of adiabatic collective motion in the fission degree of freedom. Resulting values for B are 4 to 11 times larger than those obtained from the liquid-drop model estimates. It turns out that the inertial parameter increases almost linearly with nuclear deformation. It also appears to be a sensitive function of the pairing force strength. Rough estimates of the coupling between quadrupole and hexadecapole modes seem to indicate that it may modify considerably the results obtained. The calculations are extended to the predicted superheavy region connected with $Z \approx 114$. (auth)

34816 NUCLEAR STRUCTURE AND STABILITY OF HEAVY AND SUPERHEAVY ELEMENTS. Nilsson, Sven Goesta (Univ. of California, Berkeley); Tsang, Chin Fu; Sobiczewski, Adam; Szymanski, Zdzislaw; Wycech, Slawomir; Gustafson, Christer; Lamm, Iger-Lena; Moeller, Peter; Nilsson, Bjoern. Nucl. Phys., A131: 1-66(1969).

Nuclear potential energy surfaces as a function of deformations are calculated on the basis of a modified oscillator model. In particular, quadrupole (P_2) and hexadecapole (P_4) deformations are considered. The average behavior of the surface is normalized to that of a liquid drop through the employment of a generalized Strutinsky prescription. In this way a synthesis of the single-particle model and the liquid-drop model is obtained. Lowest minima in the potential energy surfaces give the ground state masses and distortions. These results compare extremely well with experimental data. Spontaneous fission half-lives are also obtained. The inertial parameters associated with fission barrier penetration are derived empirically as well as by a microscopic model. Shape (fission) isomeric states are also found. Their N and Z dependence in the present model are discussed and results tabulated. The calculations are extended to the predicted superheavy region around Z = 114 and N = 184. The total overall stability with respect to alpha and beta decay, and spontaneous fission is found to be most favorable in the vicinity of Z = 110 and N = 184. Detailed diagrams and tables are exhibited. (auth)

34817 NILSSON MODEL FOR DEFORMED PHONONS. Lipas, P. O.; Savolainen, J. (Univ. of Helsinki). Nucl. Phys., A130: 77-87(1969).

Vibrations of deformed even nuclei are treated as vibrations in the intrinsic system projected out into rotational bands in the laboratory. A vibrational quantum is viewed as a quantized surface ripple, with a good K but not J, in analogy to a nucleon in the Nilsson well. The intrinsic Hamiltonian is taken to be of the Bohr–Mottelson type, with the parameters B_{lm}, C_{lm} and β_0 defining the deformed field. The intrinsic problem is solved in terms of the phonons of the spherical field, first in perturbation theory and then exactly. The Bogolyubov–Valatin transformation for bosons is used in the latter. By the Peieris–Yoccoz projection method, the physical states are found as certain superpositions of spherical-phonon states with various phonon numbers. The present model reproduces the usual results of the Bohr–Mottelson model; in addition, it suggests a K = 1 quadrupole-vibrational band. Finally, the coherence, or collectivity, of the projected states is discussed in terms of the B(E2) value between the two lowest states. The expected qualitative behavior is established. The B(E2) value increases as deformation sets in; slow convergence encumbers the study of large deformations. Altogether, the present work continues the phonon description of spherical nuclei to the permanently deformed ones; it forms a rather detailed examination of the long-alleged equivalence of deformation and vibration. (auth)

34818 THE TENSOR FORCE AND THE KOWALSKI–NOYES REPRESENTATION FOR THE t-MATRIX. Fuda, Michael G. (State Univ. of New York, Buffalo). Nucl. Phys., A130: 155-60(1969).

A formulation of the Kowalski–Noyes representation of the t-matrix is developed using Weinberg's quasiparticle formalism. Such a representation leads to nonsingular integral equations for the t-matrix. It also suggests a separable approximation to the t-matrix, which reduces the Faddeev equations to coupled equations in one continuous variable. This separable approximation satisfies the off-shell unitarity relation, and has the correct behavior in the neighborhood of bound-state and resonance energies. The formulation given allows for a treatment of tensor forces. (auth)

34819 AMBIGUITY OF THE GALILEAN-INVARIANT OPERATOR FOR PION ABSORPTION BY NUCLEI. Barnhill III, Maurice V. (Univ. of Virginia, Charlottesville. Univ. of Delaware, Newark). Nucl. Phys., A131: 106-12(1969). (ORO-2915-99).

The pseudoscalar–pseudoscalar pion–nucleon interaction is reduced to terms of order $(1/M)^3$ by a Foldy–Wouthuysen reduction, in order to derive the form of an appropriate nonrelativistic Hamiltonian for pion absorption by nuclei. It is pointed out that the reduction is not unique and that the various possible reductions correspond to the application of various canonical transformations to any one of the reduced Hamiltonians. The conventional "Galilean-invariant" interaction is obtained from one of these reductions; however, the coefficient of a term that makes a significant contribution to actual calculations of pion absorption in light and medium nuclei is not well defined by the reduction procedure alone. (auth)

34820 RELATION BETWEEN NUCLEAR LEVEL DENSITY PARAMETERS AND MASS SHELL CORRECTIONS. Brancazio, P. J. (Brooklyn Coll. Yeshiva Univ., New York); Cameron, A. G. W. Can. J. Phys. 47: 1029-35(May 1, 1969).

Previous work by Gilbert and Cameron has demonstrated a linear relation between the nuclear level density parameter a and the mass shell correction S. However, different relations were obtained for deformed and undeformed nuclei. It is shown that a single relation can be obtained if a deformation energy is added to the reference mass formula. This deformation energy is shown to be proportional to the number of neutrons or protons to the nearest closed shell. (auth) (Canada)

REACTOR TECHNOLOGY

Commercial Power Reactors

34821 (DOCKET-50010-23) DRESDEN NUCLEAR POWER STATION, [UNIT 1]. [Preliminary Hazards Summary Report]. Supplementary Data on the Proposed Dresden High Void Test. (Commonwealth Edison Co., Chicago, Ill.). Sept. 26, 1961. 33p. Dep. CFSTI.

The complete systems equations and transfer functions used in the safety analyses of the Dresden Power Reactor, Unit 1 high void tests are given. Detailed analog computer block and wiring diagrams are shown. Experimental and analog computer data are correlated for a large boiling water reactor. The physical phenomena relating changes in pressure to void reactivity effects are discussed. Separation of reactor steam flow under high void test conditions are analyzed. (M.L.S.)

34822 (DOCKET-50010-24) DRESDEN NUCLEAR POWER STATION, [UNIT 1]. [Preliminary Hazards Summary Report]. Additional Information on Proposed Improvements to the Liquid Poison System. (Commonwealth Edison Co., Chicago, Ill.). Oct. 15, 1961. 13p. Dep. CFSTI.

A schematic of the proposed redesign of the liquid poison injection system for the Dresden Power Reactor, Unit 1 is shown. Criteria and codes used for the redesign are listed. Specifications are given for the liquid poison tank, pump, liquid level switch, and injection valve. (M.L.S.)

34823 (DOCKET-50010-25) DRESDEN NUCLEAR POWER STATION, [UNIT 1]. REPORT NO. 3. TEST OPERATION OF THE DRESDEN REACTOR AT POWER LEVEL TO 315 MW. (Commonwealth Edison Co., Chicago, Ill.). Apr. 27, 1960. 22p. Dep. CFSTI.

Results of the testing of Dresden Power Reactor, Unit 1 to 50% rated power are discussed. Initial loading and testing are summarized; problems encountered with control rod drives are described. Low power testing and incremental power increases to 315 MW are described. Equipment and startup checkouts are outlined. Results of temperature coefficient measurements and control rod scram tests are given. Thermal and hydraulic performance of the nuclear steam supply system are described. Power distribution, stability, and transient test results are summarized. Power operation at 315 MWe is described in some detail. (M.L.S.)

34824 (DOCKET-50010-26) [DRESDEN NUCLEAR POWER STATION, UNIT 1]. REPORT NO. 2. TEST OPERATION OF THE DRESDEN REACTOR AT ATMOSPHERIC PRESSURE WITH THE REACTOR VESSEL HEAD REMOVED. (Commonwealth Edison Co., Chicago, Ill.). Apr. 15, 1960. 12p. Dep. CFSTI.

Test operation, with the Dresden Power Reactor, Unit 1 pressure vessel head removed, is summarized. The demonstration of conformance with Technical Specifications and license requirements is delineated. Control rod operational experience since completion of drive modifications is described. (M.L.S.)

34825 (DOCKET-50010-27) DRESDEN NUCLEAR POWER STATION, [UNIT 1]. [Preliminary Hazards Summary Report]. Control Blade Revisions. (Commonwealth Edison Co., Chicago, Ill.). Feb. 27, 1961. 13p. Dep. CFSTI.

Proposed design revisions to the control rod blades for the Dresden Power Reactor, Unit 1 are discussed. Schematics of the design revision are shown; design data are presented graphically. Safety implications of the new design are assessed. (M.L.S.)

34826 (DOCKET-50010-28) DRESDEN NUCLEAR POWER STATION, [UNIT 1]. [Preliminary Hazards Summary Report]. Low Level Testing and Reconstitution of the Operational Core. (Commonwealth Edison Co., Chicago, Ill.). Feb. 28, 1961. 6p. Dep. CFSTI.

Instrumentation for use in the low level testing of the Dresden Power Reactor, Unit 1 is described. Reloading criteria for the stainless steel clad and radioactive fuel elements from the first core loading are listed. (M.L.S.)

34827 (DOCKET-50010-29) DRESDEN NUCLEAR POWER STATION, [UNIT 1]. Fourth Quarterly Report of Station Operation. (Commonwealth Edison Co., Chicago, Ill.). Oct. 31, 1961. 10p. Dep. CFSTI.

An operations history for the Dresden Power Reactor, Unit 1 for the period July 1–September 30, 1961 is given. Load restrictions, and reasons for these, are tabulated. Radioactive waste disposal is discussed. Notices of modifications pursuant to operating license DPR-2 are listed. (M.L.S.)

34828 (DOCKET-50010-30) DRESDEN NUCLEAR POWER STATION, [UNIT 1]. [Preliminary Hazards Summary Report]. Additional Information on Proposed Increase in Primary and Secondary Steam Flow Rates. (Commonwealth Edison Co., Chicago, Ill.). Jan. 5, 1962. 38p. Dep. CFSTI.

Results of thermal-hydraulic analyses are tabulated for rated power and 125% rated power for the Dresden Power Reactor, Unit 1. Void content is correlated with associated burnout ratios. Conditions for the determination of burnout limit curves are tabulated; data for these curves are discussed. (M.L.S.)

34829 (DOCKET-50010-31) [DRESDEN NUCLEAR POWER STATION, UNIT 1]. License No. DPR-2: Amendments to Appendix A. (Commonwealth Edison Co., Chicago, Ill.). Jan. 5, 1962. 67p. Dep. CFSTI.

A description of the proposed amendments to DPR-2, the operating license for Dresden Power Reactor, Unit 1 is listed. Physical characteristics and mechanical design of the ten slightly different fuel elements are given. Thermal and hydraulic characteristics of scattered and centrally loaded core configurations are described. Nuclear characteristics of the various fuel assemblies are summarized. A detailed safety evaluation of the proposed use of the fuel is given. Data to support a request for increase of power from 630 MW to 700 MW are included. (M.L.S.)

34830 (DOCKET-50010-32) DRESDEN NUCLEAR POWER STATION, [UNIT 1]: OPERATION AND PERFORMANCE. (Commonwealth Edison Co., Chicago, Ill.). Mar. 29, 1962. 129p. Dep. CFSTI.

The operation and performance of the Dresden Power Reactor, Unit 1 are detailed under the following broad topics: Plant Description; Operation, Radiation Protection and Maintenance; Performance Measurements; Power Generation Statistics, Load Schedules, and Water Chemistry; Modification and Inspection of Reactor Components; and Reactor Performance and the Factors Affecting Economic Operation. (M.L.S.)

34831 (DOCKET-50010-33) DRESDEN NUCLEAR POWER STATION, [UNIT 1]. [Preliminary Hazards Summary Report]. Technical Support for Increasing Power from 630 to 700 MWT. (Commonwealth Edison Co., Chicago, Ill.). Apr. 6, 1962. 14p. Dep. CFSTI.

Details of thermohydraulic studies for various core configurations in Dresden Power Reactor, Unit 1 are given. Minimum burnout ratios at overpower condition are calculated; burnout ratios and peak heat fluxes are tabulated. The safety of an increase in fuel heat flux limits is evaluated. (M.L.S.)

34832 (DOCKET-50010-34) DRESDEN NUCLEAR POWER STATION, [UNIT 1]. Fifth Quarterly Report of Station Operation, October–December 1961. (Commonwealth Edison Co., Chicago, Ill.). May 15, 1962. 16p. Dep. CFSTI.

The operations history for the Dresden Power Reactor, Unit 1 is given for the period October–December 1961. Scheduled and unscheduled scrams are described; power generation statistics are given. Changes in wiring for the recirculation pump are described; radioactive waste disposals are recorded. Results of tests, which were performed in the period, are tabulated. Fuel element transfer and reloading activities are tabulated. (M.L.S.)

34833 (DOCKET-50010-35) DRESDEN NUCLEAR POWER STATION, [UNIT 1]: SUMMARY OF DYNAMIC STRESS ANALYSIS OF CORE SUPPORT GRID. Robinson, T. F. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). May 17, 1962. 14p. Dep. CFSTI.

Results of an analysis of the dynamic loading of the core support grid for Dresden Power Reactor, Unit 1 are detailed. Equations, used for an equivalent beam with ends tied to a surrounding ring structure, were solved for dynamic and static loads on the grid; the equations and assumptions are given; results are tabulated. The proposed inspection program is outlined. (M.L.S.)

34834 (DOCKET-50010-36) [DRESDEN NUCLEAR POWER STATION, UNIT 1]. [Preliminary Hazards Summary Report]. Additional Information on Heat Flux Limit Increase and Power Level Increase at Dresden. (Commonwealth Edison Co., Chicago, Ill.). May 28, 1962. 116p. Dep. CFSTI.

Data and analyses from mockup and irradiation testing of high heat flux fuel elements for the Dresden Power Reactor, Unit 1 are given. Core heat up analyses are discussed; results are shown graphically. Changes in value for moderator temperature coefficient are reported. Reactivity values are compared before and after poison blade removal. Specifica-

tions for liquid poison injection system modifications are included. Test procedures and descriptions of the proposed high void test are summarized. Specifications for a new bottom core support assembly are presented. Details of the operation of the hydraulic control blade drive system are given. (M.L.S.)

34835 (DOCKET-50010-37) DRESDEN NUCLEAR POWER STATION, [UNIT 1]. Annual Report of Station Operation for the Year 1963. (Commonwealth Edison Co., Chicago, Ill.). Jan. 17, 1964. 55p. Dep. CFSTI.

A complete operations history for the Dresden Power Reactor, Unit 1 is given for 1963. Power generation statistics are reported; records of reactor and turbine generator service are included. Load restrictions and causes are tabulated; scheduled and unscheduled scrams are listed and described. Thermal-hydraulic and flux transient limits are tabulated. Control rod drive testing is summarized. Radioactive waste disposal, for the year, is reported. Brief descriptions of all the tests performed during the year are given. Turbine-generator trip test data are tabulated. Results of examination of the failed fuel assemblies are listed. (M.L.S.)

34836 (DOCKET-50010-38) [DRESDEN NUCLEAR POWER STATION, UNIT 1]. Operating License DPR-2: Request for Amendment to Allow Use of Type V Fuel Assemblies. (Commonwealth Edison Co., Chicago, Ill.). Oct. 6, 1966. 17p. Dep. CFSTI.

Design parameters for the Dresden Power Reactor, Unit 1 fuel elements are tabulated. Nuclear and mechanical characteristics of a special test fuel element, Type V, are discussed; use of Gd_2O_3 as a burnable poison in the fuel elements is evaluated; a schematic of the fuel element and a loading diagram showing their core position are shown. Limiting temperature and void coefficients and average lattice data are tabulated for an assembly. (M.L.S.)

34837 (DOCKET-50010-39) [DRESDEN NUCLEAR POWER STATION, UNIT 1]. DPR-2: Request for Change to Technical Specifications. (Commonwealth Edison Co., Chicago, Ill.). Jan. 9, 1967. 11p. Dep. CFSTI.

A description of special test fuel elements for the Dresden Power Reactor, Unit 1 is given. These test fuel elements are Pu rods which will replace the $Gd_2O_3-UO_2$. The mechanical, thermal-hydraulic, and nuclear behavior of the fuel elements are considered. Safety aspects of the use of the Pu rods in-core are considered. (M.L.S.)

34838 (DOCKET-50010-40) [DRESDEN NUCLEAR POWER STATION, UNIT 1]. DPR-2: Request for Change to Technical Specifications. (Commonwealth Edison Co., Chicago, Ill.). Jan. 31, 1967. 11p. Dep. CFSTI.

Design features of a special fuel assembly (SA-1) for the Dresden Power Reactor, Unit 1 are described; design parameters are tabulated. The previous irradiation history of the SA-1 rods is described; results of thermal and hydraulic analyses are tabulated. (M.L.S.)

34839 (DOCKET-50010-41) [DRESDEN NUCLEAR POWER STATION, UNIT 1]. Summary Description of Inspection. (Commonwealth Edison Co., Chicago, Ill.). June 2, 1967. 79p. Dep. CFSTI.

The inspection of Dresden Power Reactor, Unit 1 during the refueling outage in the first quarter of 1967 is discussed. The inspection and maintenance of the control rod drives are summarized; results of inspection of failed drives are described. Failures of fuel assembly channel tab welds and bale cap screws are analyzed. Details of core inspection to determine causes of gradual increase in pressure drop are given; fuel cleaning and flow testing are discussed; flow test data are tabulated. Minimum critical heat flux ratio calculations for the core are described; data are tabulated. (M.L.S.)

34840 (DOCKET-50010-42) DRESDEN NUCLEAR POWER STATION, [UNIT 1]. DPR-2: Proposed Technical Specifications Change No. 14. (Commonwealth Edison Co., Chicago, Ill.). Sept. 14, 1967. 44p. Dep. CFSTI.

The physical, thermal-hydraulic, and nuclear properties of the instrumented $Gd_2O_3-UO_2$ fuel elements for reloading Dresden Power Reactor, Unit 1 are discussed. Safety aspects of the use of the instrumented fuel assemblies are considered. (M.L.S.)

34841 (DOCKET-50010-44) [DRESDEN NUCLEAR POWER STATION, UNIT 1]. DPR-2: Installation of Control Rod Drive Thimble Supports. (Commonwealth Edison Co., Chicago, Ill.). Jan. 18, 1968. 14p. Dep. CFSTI.

A description and safety evaluation of the control rod drive thimble support for Dresden Power Reactor, Unit 1 is given. Proposed design bases are delineated; testing requirements are summarized. A materials list is given; stresses at possible critical points are tabulated. (M.L.S.)

34842 (DOCKET-50155-9) BIG ROCK POINT PLANT. License No. DPR-6: Operation Report, November 1, 1968-April 30, 1969. (Consumers Power Co., Jackson, Mich.). June 11, 1969. 11p. Dep. CFSTI.

34843 (DOCKET-50219-21) OYSTER CREEK NUCLEAR POWER PLANT, UNIT NO. 1. [Preliminary Safety Analysis Report], Amendment 40. (Jersey Central Power and Light Co., Morristown, N. J.). Aug. 30, 1968. 70p. Dep. CFSTI.

Details of the reactor vessel repair program for Oyster Creek Power Reactor, Unit 1 are given. Results of examinations of all vessel components which were fabricated of the Type 304 sensitized stainless steel are given. Areas where intergranular cracking of the sensitized stainless has occurred are described. Further modifications which have been made on other furnace sensitized stainless components are discussed. Repair procedures are included. Measurements of stub tube deformations, associated with the field welding, are described. (M.L.S.)

34844 (DOCKET-50220-25) NINE MILE POINT NUCLEAR STATION. Final Safety Analysis Report, Amendment 13, Suppl. 8, Exhibit D-10. (Niagara Mohawk Power Corp., Syracuse, N. Y.). Apr. 1969. 12p. Dep. CFSTI.

Technical qualifications for personnel for the Nine Mile Point Power Reactor are listed. Personnel organization and duties are defined. (M.L.S.)

34845 (DOCKET-50220-26) NINE MILE POINT NUCLEAR STATION. Safety Evaluation by the Division of Reactor Licensing. (Niagara Mohawk Power Corp., Syracuse, N. Y.). May 26, 1969. 33p. Dep. CFSTI.

The complete safety evaluation of the Nine Mile Point Power Reactor by the AEC Division of Reactor Licensing is included. Consideration is given to: site and environment, facility design, electrical power, instrumentation and controls, analyses of design basis accidents, emergency planning, technical specifications, ACRS report, common defense and security. (M.L.S.)

34846 (DOCKET-50231-28) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Preliminary Safeguards Summary Report, Part I. Application for Construction Permit and Operating License. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Jan. 22, 1965. 296p. Dep. CFSTI.

Revised data for the site of SEFOR are presented. Design parameters for first and second containment barriers of SEFOR are described. Revised data are presented for the reactor vessel. The Core 1 design parameters are listed. Control rods and control rod drive systems for the SEFOR are illustrated. Shielding performance in the SEFOR is analyzed. Buildings and plant layout for the SEFOR are illustrated. Circuit diagrams for the SEFOR cooling and service systems are presented. The SEFOR refueling and fuel storage systems are described. Circuit diagrams for the external power systems are included. Radiation monitoring systems are described. The waste disposal systems are illustrated. Results of criticality testing and ZPR 3 testing are presented. Startup and operation procedures are listed. Safety systems for failures and malfunctions are described. Additions to Appendix A include site test boring analysis. (D.C.C.)

34847 (DOCKET-50231-29) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Preliminary Safeguards Summary Report, Part II. Application for Construction Permit and Operating License. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). Jan. 22, 1965. 16p. Dep. CFSTI.

Illustrations of the SEFOR pressure vessel and core arrangement are presented. Design parameters for the core are listed. The SEFOR refueling and fuel storage systems are described. (D.C.C.)

34848 (DOCKET-50231-30) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Facility Description and Safety Analysis Report, Vol. 1. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). July 24, 1967. 308p. Dep. CFSTI.

Information on Southwest Experimental Fast Oxide Reactor is presented under the following broad topics: Introduction; Summary; Site and Environs; Reactor System; Reactor Coolant Systems; Plant Shielding System; Containment System; Engineered Safeguards; Radioactive Waste Control Systems; and Plant Safety and Control Instrumentation Systems. (D.C.C.)

34849 (DOCKET-50231-31) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Facility Description and Safety Analysis Report, Vol. 2. (General Electric Co., Sunnyvale, Calif. Advanced Products Operation). July 24, 1967. 324p. Dep. CFSTI.

Information on Southwest Experimental Fast Oxide Reactor is

presented under the following broad topics: Plant Auxiliary and Service Systems; Experimental Program; Experimental Equipment; Conduct of Operations; Electrical Power Supply; and Safety Analysis. Appendices contain information on: an analog model of SEFOR; summary of results of the SEFOR mockup experiments in ZPR 3; blast shielding and containment design; and radiological effects calculations, alternate methods. (D.C.C.)

34850 (DOCKET-50244-19) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1. Final Facility Description and Safety Analysis Report, Amendment 19, Suppl. 12, Exhibit D-16. (Rochester Gas and Electric Corp., N. Y.). Apr. 16, 1969. 173p. Dep. CFSTI.

Revised information is presented for the Robert E. Ginna Power Reactor Unit 1 cooling system. Flow diagrams and hydraulic variations are presented. Design parameters related to boiler tube vibrations are described. Fracture mechanics for the coolant pump flywheel are evaluated. Quality assurance inspection procedures for electroslag welds are described. Stress analysis results for cooling system pipes are presented. Materials used for tendons in the pressure vessel are listed. The effects of accident environment on electrical cables are described. Control rod drive systems are analyzed. Emergency procedures are listed for various accident conditions. (D.C.C.)

34851 (DOCKET-50244-20) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1. Emergency Procedures and Plans. (Rochester Gas and Electric Corp., N. Y.). May 16, 1969. 42p. Dep. CFSTI.

Emergency procedures and plans for the Robert E. Ginna Power Reactor, Unit 1 are detailed. Training programs for plant personnel are described; emergency responsibilities and assignments are defined. (M.L.S.)

34852 (DOCKET-50244-21) [ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1]. Supplementary Information to Final Safety Analysis Report. (Rochester Gas and Electric Corp., N. Y.). May 28, 1969. 7p. Dep. CFSTI.

Supplementary information on Robert E. Ginna Power Reactor, Unit 1 is given on: conditions for possible site flooding, installation of a strong motion accelerograph, and a system for monitoring abnormal power distributions. (M.L.S.)

34853 (DOCKET-50244-22) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT NO. 1. Additional Information on Seismic Design of Class I Piping. (Rochester Gas and Electric Corp., N. Y.). June 9, 1969. 110p. Dep. CFSTI.

The seismic design of the Class I piping systems for the Robert E. Ginna Power Reactor, Unit 1 is detailed. Results of statics calculations of piping stresses are tabulated for Class I systems; these calculated stresses are compared with allowable stresses. The most critical Class I piping support loads are listed, and seismic amplification factors associated with each support are given. Results of the stress analyses are analysed. Seismic analyses of Class I main steam piping are given; data are shown graphically. Startup organization is detailed. (M.L.S.)

34854 (DOCKET-50244-23) REPORT ON THE MAXIMUM PROBABLE WATER LEVEL FOR THE GINNA PLANT SITE. (Rochester Gas and Electric Corp., N. Y.). July 1, 1969. 16p. Dep. CFSTI.

Analysis of storm effects and associated wave action at the Robert E. Ginna Power Reactor, Unit 1 site is detailed. Values for maximum probable water levels are given. Effects of wave height and probable runup along the armorstone breakwall are considered. Computational procedures are outlined. (M.L.S.)

34855 (DOCKET-50245-15) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Final Safety Analysis Report, Amendment 15. (Connecticut Light and Power Co., Hartford. Hartford Electric Light Co., Conn. Western Massachusetts Electric Co., Greenfield. Millstone Point Co., Wethersfield, Conn.). June 24, 1969. 93p. Dep. CFSTI.

A failure mode analysis is given for the Millstone Power Reactor gas turbine generator system. Tornado design criteria used in facility design are described. Use of non-carburized jet pump castings is discussed. Protection of the Emergency Core Cooling Systems (ECCS) pumps against flooding as a result of excessive leakage in the ECCS piping complex is described. Effects of the probable maximum hurricane are analyzed. Pages containing revised or additional information to the Final Safety Analysis Report are included. (M.L.S.)

34856 (DOCKET-50255-15) PALISADES PLANT. Final Safety Analysis Report, Amendment 11. (Consumers Power Co., Jackson, Mich.). Apr. 28, 1969. 152p. Dep. CFSTI.

Results of prototype testing for effects of post-accident environment on equipment located inside the containment vessel of the Palisades Power Reactor are given; data are tabulated. The quality assurance program and specifications for the reactor protective system are detailed. Systems assigned to each emergency diesel are tabulated; diesel loadings and capabilities are discussed. Effects of loss of air to air-operated valves are discussed; valve position is tabulated for normal, shutdown, and air-loss positions. Effects of instrument air loss to ventilation dampers are discussed. Emergency plans are detailed: on-site and local medical facilities are described. Schematics and diagrams for all modifications or revisions to systems or equipment are included. (M.L.S.)

34857 (DOCKET-50255-16) PALISADES PLANT. Final Safety Analysis Report, Amendment 12. (Consumers Power Co., Jackson, Mich.). May 13, 1969. 62p. Dep. CFSTI.

Effects of rupture of a service water piping line for the Palisades Power Reactor is analyzed; service water system valves are tabulated. The stack monitoring system is described. Plant organization and personnel are discussed. The maximum hypothetical accident is analyzed. Site meteorology is detailed; meteorologic factors are tabulated. (M.L.S.)

34858 (DOCKET-50263-21) MONTICELLO NUCLEAR GENERATING PLANT, UNIT NO. 1. Final Safety Analysis Report, Amendment 14. (Northern States Power Co., Minneapolis, Minn.). May 15, 1969. 462p. Dep. CFSTI.

Revised or additional information is included on all sections of the Final Safety Analysis Report (FSAR) for the Monticello Power Reactor. Corrections and additions are also included for all Appendices to the FSAR. (M.L.S.)

34859 (DOCKET-50289-10) THREE MILE ISLAND NUCLEAR STATION [UNIT 1]. Preliminary Safety Analysis Report, Amendment 6. (Metropolitan Edison Co., Reading, Pa.). Jan. 8, 1968. 145p. Dep. CFSTI.

Damping factors used for the seismic design of the Three Mile Island Power Reactor, Unit 1 are given; design criteria are specified. Required net positive suction head for the recirculation pumps is discussed. Coolant loss accidents are analyzed for a spectrum of break sizes and locations; results of the analyses are shown graphically. Details regarding the concrete and reinforced steel construction materials are given. Containment vessel liner construction is described. Use of core barrel check valves is discussed. (M.L.S.)

34860 (DOCKET-50289-11) THREE MILE ISLAND NUCLEAR STATION [UNIT 1]. Preliminary Safety Analysis Report, Amendment 11. (Metropolitan Edison Co., Reading, Pa.). July 1, 1968. 57p. Dep. CFSTI.

Use of 170 post-tensioning tendons in the reactor containment building of the Three Mile Island Power Reactor, Unit 1, rather than the original 90, is discussed. The anchorage zone design of the prestressing tendons is described; bearing stresses and transverse tensile forces are calculated. Schematics show the details of the design. Details of the prestressing materials and hardware are given. A complete copy of the "Report of Design and Testing of End Anchorages for the 170 Wire BBRV System" is included. (M.L.S.)

34861 (DOCKET-50289-12) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Preliminary Safety Analysis Report, Amendment 9. (Metropolitan Edison Co., Reading, Pa.). Mar. 6, 1968. 13p. Dep. CFSTI.

Additional details of a hypothetical aircraft incident at the Three Mile Island Power Reactor, Unit 1 are given. Principal structures and components are tabulated with their capabilities for withstanding strike-related loadings. Studies to determine plant materials failures, in the event of an aircraft crash are discussed; results of the studies are summarized. (M.L.S.)

34862 (DOCKET-50317-14) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Safety Evaluation by the Division of Reactor Licensing. (Baltimore Gas and Electric Co., Md.). Apr. 9, 1969. 105p. (DOCKET-50318-14). Dep. CFSTI.

The complete safety evaluation of the Calvert Cliffs Power Reactor, Units 1 and 2 is included. Consideration is given to: site, nuclear steam supply system, plant design, waste processing system, engineered safety features, accident analyses, research and development, technical qualifications, quality assurance, ACRS report, and common defense and security. All appendices are included, also. (M.L.S.)

34863 (DOCKET-50317-15) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. [Preliminary Safety Analysis Report], Amendment 10. (Baltimore Gas and Electric Co., Md.). Apr. 25, 1969. 26p. (DOCKET-50318-15). Dep. CFSTI.

CALVERT CLIFFS POWER REACTOR, UNIT 1—owners of, 1968 Annual Report on

CALVERT CLIFFS POWER REACTOR, UNIT 2—owners of, 1968 Annual Report on (M.L.S.)

34864 (DOCKET-50320-13) THREE MILE ISLAND NUCLEAR STATION, UNIT 2. Preliminary Safety Analysis Report, Amendment 9. (Metropolitan Edison Co., Reading, Pa. Jersey Central Power and Light Co., Morristown, N. J.). May 7, 1969. 43p. Dep. CFSTI.

Organization and technical responsibility for the design and construction of Three Mile Island Power Reactor, Unit 2 is discussed. Responsibilities in executing the quality assurance program are outlined. Emergency core cooling and functioning of isolation valves are discussed. (M.L.S.)

34865 (DOCKET-50320-14) THREE MILE ISLAND NUCLEAR STATION, UNIT 2. Preliminary Safety Analysis Report, Amendment 10. (Metropolitan Edison Co., Reading, Pa. Jersey Central Power and Light Co., Morristown, N. J.). June 4, 1969. 51p. Dep. CFSTI.

Environmental data on the Three Mile Island Power Reactor, Unit 2 site, which have been taken to date, are tabulated. Design of the reactor protection systems is discussed; design and modifications are shown schematically. Seismic analyses of core and internals are detailed. Probability of coolant pump flywheel failure is analyzed in detail. (M.L.S.)

34866 (DOCKET-50321-10) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Preliminary Safety Analysis Report, Amendment 6. (Georgia Power Co., Atlanta). Apr. 28, 1969. 24p. Dep. CFSTI.

The design basis for the Emergency Core Cooling System suction piping for the Edwin I. Hatch Power Reactor, Unit 1 is described. Special requirements for the main steam piping system are outlined; the design of piping within the primary coolant pressure boundary is described. Changes in previously submitted seismic design criteria are detailed. The design and functioning of the rod block monitor are discussed. Design bases for the engineered safety features are analyzed. (M.L.S.)

34867 (DOCKET-50323-4) NUCLEAR PLANT, DIABLO CANYON SITE, UNIT 2. Preliminary Safety Analysis Report, Amendment 1. (Pacific Gas and Electric Co., San Francisco, Calif.). May 12, 1969. 177p. Dep. CFSTI.

Core design for the Diablo Canyon Power Reactor, Unit 2 is discussed; design bases are described; design parameters are tabulated. Procedures for control rod actuation are listed; control rod design is described; design data are tabulated. Applicable codes and specifications for the design of the primary system are listed; the quality assurance program for the primary system is summarized. Design bases for the electrical systems are given; station service systems and emergency power systems are described. Design bases, codes, and classifications used for the steam and power conversion system are given; the systems design is evaluated. Reactor and plant personnel, training and responsibilities are described. (M.L.S.)

34868 (DOCKET-50323-5) NUCLEAR PLANT, DIABLO CANYON SITE, UNIT 2. Preliminary Safety Analysis Report, Amendment 2. (Pacific Gas and Electric Co., San Francisco, Calif.). May 12, 1969. 325p. Dep. CFSTI.

Seismic design of the Diablo Canyon Power Reactor, Unit 2 is discussed; environmental radioactivity surveys, performed at the site are detailed. Design and operation of the Emergency Core Cooling Systems (ECCS) is described; design parameters are tabulated for the boron injection tank, centrifugal charging pumps, safety injection pumps, and residual heat removal pumps. A detailed evaluation of the ECCS design is included; a single active failure analysis is tabulated for the ECCS; schematics of the ECCS are included, also. Containment piping penetrations and valving are listed. Chemical and volume control system performance requirements and component design data are tabulated. Design and operation of the component cooling water system is described; design parameters and minimum flow requirements are tabulated. The design of the auxiliary salt water system is discussed; system components are described; a malfunction analysis is included. Processing of liquid waste is discussed; code requirements for the waste disposal system components are listed. Schematics of the waste disposal system are included. (M.L.S.)

34869 (DOCKET-50324-10) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 7, Suppl. 5. (Carolina Power and Light Co., Raleigh, N. C.). May 5, 1969. 88p. (DOCKET-50325-10). Dep. CFSTI.

Response of the Brunswick Power Reactor, Units 1 and 2, to loss of off-site power is described. Wave runup calculations during the Probable Maximum Hurricane at the Brunswick Site are given; effects on buildings are evaluated. Fuel failure modes are discussed. Responsibilities and organization of the quality assurance program are defined. Details on the failed fuel element detection system design are given. Stress and deformation criteria limits are defined for Class I components. Information on the rod block monitoring system is detailed. A hypothetical fuel cask drop accident is analyzed. Response of the engineered safety features to the radiation environment following a design basis accident is evaluated. (M.L.S.)

34870 (DOCKET-50324-11) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 9, Suppl. 6. (Carolina Power and Light Co., Raleigh, N. C.). June 30, 1969. 60p. (DOCKET-50325-11). Dep. CFSTI.

Flood protection of the Brunswick Power Reactor, Units 1 and 2, is discussed. Problems which are peculiar to boiling water reactors are considered. Design details of the rod block monitor system are given; schematics are included. The flow reference scram is described; scram reliability is evaluated. Design bases for engineered safeguards are described. Long term integrity of the core standby cooling system is evaluated. The design of the main steam line is described. (M.L.S.)

34871 (DOCKET-50342-1) [VERPLANCK NUCLEAR GENERATING STATION, UNITS 4 AND 5]. Applications for Licenses. (Consolidated Edison Co. of New York, Inc., New York). June 3, 1969. 39p. (DOCKET-50343-1). Dep. CFSTI.

The license application for Consolidated Edison's Nuclear Generating Station, Units 4 and 5, at Verplanck, N. Y. is included. The financial qualifications of Consolidated Edison are listed; projected plant costs are given. Summary biographies are presented for the Trustees and Principal Officers. The complete 1968 Annual Report is included. (M.L.S.)

34872 (DOCKET-50342-2) [VERPLANCK] NUCLEAR GENERATING UNITS 4 AND 5. Preliminary Safety Analysis Report, Vol. 1, Exhibit C. (Consolidated Edison Co. of New York, Inc., New York). June 3, 1969. 350p. (DOCKET-50343-2). Dep. CFSTI.

VERPLANCK POWER REACTOR, UNIT 1—site for, preliminary safety analysis of
VERPLANCK POWER REACTOR, UNIT 2—site for, preliminary safety analysis of (M.L.S.)

34873 (DOCKET-50342-3) [VERPLANCK] NUCLEAR GENERATING UNITS 4 AND 5. Preliminary Safety Analysis Report, Vol. 2, Exhibit C. (Consolidated Edison Co. of New York, Inc., New York). June 3, 1969. 400p. (DOCKET-50343-3). Dep. CFSTI.

VERPLANCK POWER REACTOR, UNIT 1—core for, preliminary safety analysis of design for
—cooling system for, preliminary safety analysis of design for
—containment systems for, preliminary safety analysis of
—engineered safeguards for, preliminary safety analysis of
VERPLANCK POWER REACTOR, UNIT 2—core for, preliminary safety analysis of design
—cooling system for, preliminary safety analysis of design for
—containment systems for, preliminary safety analysis of
—engineered safeguards for, preliminary safety analysis of (M.L.S.)

34874 (DOCKET-50342-4) [VERPLANCK] NUCLEAR GENERATING UNITS 4 AND 5. Preliminary Safety Analysis Report, Vol. 3, Exhibit C. (Consolidated Edison Co. of New York, Inc., New York). June 3, 1969. 425p. (DOCKET-50343-4). Dep. CFSTI.

VERPLANCK POWER REACTOR, UNIT 1—control systems and instrumentation for, preliminary safety analysis of
—electrical systems for, preliminary safety analysis of
—emergency and auxiliary systems for, preliminary safety analysis of
—steam and power conversion systems for, preliminary safety analysis of
VERPLANCK POWER REACTOR, UNIT 2—control systems and instrumentation for, preliminary safety analysis of
—electrical systems for, preliminary safety analysis of
—emergency and auxiliary systems for, preliminary safety analysis of
—steam and power conversion systems for, preliminary safety analysis of (M.L.S.)

34875 (DOCKET-50342-5) [VERPLANCK] NUCLEAR GENERATING UNITS 4 AND 5. Preliminary Safety Analysis Report, Vol. 4, Exhibit C. (Consolidated Edison Co. of New York, Inc., New York). June 3, 1969. 459p. (DOCKET-50343-5). Dep. CFSTI.

VERPLANCK POWER REACTOR, UNIT 1—radiation protection

and waste disposal at, preliminary safety analysis of
—operation of, preliminary safety analysis of proposed
—safety evaluation of, preliminary
—design criteria for
—quality assurance program for, preliminary
VERPLANCK POWER REACTOR, UNIT 2—radiation protection and waste disposal at, preliminary safety analysis of
—operation of, preliminary safety analysis of proposed
—safety evaluation of, preliminary
—design criteria for
—quality assurance program for, preliminary (M.L.S.)

34876 (DOCKET-50344-1) TROJAN NUCLEAR PLANT. Preliminary Safety Analysis Report, Vol. 1. (Portland General Electric Co., Oreg.). June 25, 1969. 378p. Dep. CFSTI.

TROJAN POWER REACTOR, UNIT 1—site for, preliminary safety analysis of
—core for, preliminary safety analysis of design for
—cooling system for, preliminary safety analysis of design for (M.L.S.)

34877 (DOCKET-50344-2) TROJAN NUCLEAR PLANT. Preliminary Safety Analysis Report, Vol. 2. (Portland General Electric Co., Oreg.). June 25, 1969. 452p. Dep. CFSTI.

TROJAN POWER REACTOR, UNIT 1—containment systems for, preliminary safety analysis of
—engineered safeguards for, preliminary safety analysis of
—control systems and instrumentation for, preliminary safety analysis of
—electrical systems for, preliminary safety analysis of
—emergency and auxiliary systems for, preliminary safety analysis of (M.L.S.)

34878 (DOCKET-50344-3) TROJAN NUCLEAR PLANT. Preliminary Safety Analysis Report, Vol. 3. (Portland General Electric Co., Oreg.). June 25, 1969. 325p. Dep. CFSTI.

TROJAN POWER REACTOR, UNIT 1—steam and power conversion systems for, preliminary safety analysis of
—radiation protection and waste disposal at, preliminary safety analysis of
—operations of, preliminary safety analysis of proposed
—safety evaluation of, preliminary
—Technical Specifications for, outline of proposed
—structures, systems, and equipment for, design bases for
—design of, compliance with general design criteria (M.L.S.)

34879 MUEHLEBERG: SECOND SWISS NUCLEAR POWER STATION. Auer, Werner P. (Ecole Polytechnique, Zurich. Brown-Boveri, Baden, Switzerland); Meichle, Adolphe W. Ind. At., 13: Nos. 3-4, 71-82(1969). (In French).

The "Forces motrices bernoises S. A." (F.M.B.) are constructing a nuclear power plant near Mühleberg, 14 km west of Bern. The site chosen is on the left bank of the Aar, downstream from the existing hydroelectric plant and its 220/150 kV transformer and distribution plant. The plant will be equipped with a boiling water reactor of the General Electric type. With a total power of 306 MW(e), it will produce 2.1 billion kWh for an annual operation of 7000 hours at full load. The fissionable matter comes in the form of slightly enriched uranium dioxide. In order to construct this plant, the F.M.B. entered into a contract with a consortium composed of Brown, Boveri & Cie (B.B.C.), of Baden, and General Electric Technical Services Co. Inc. (GETSCO), of New York. The work began in the Spring of 1967 and will cover a period of 54 months. The installation will be in operation by Autumn 1971. (auth)

34880 LUCENS REACTOR ACCIDENT: A PRELIMINARY REPORT. Nucl. Eng. Int., 14: 502-3(June 1969).

The incident which occurred at the Swiss gas-cooled heavy water reactor during the raising of the power level following a planned shutdown is described. The primary circuit was breached and almost all the heavy water coolant was released into the reactor cavern. Observations made during the first phase of the incident are noted, and a description is given of the monitoring procedures adopted following leakage of radioactivity from the reactor cavern to surrounding rooms. The leakage was found to be associated with the biological shield. Investigations into the primary cause of the incident are continuing. (UK)

34881 PRELIMINARY REPORT ON THE INCIDENT WHICH OCCURRED ON 21st JANUARY 1969 IN THE LUCENS EXPERIMENTAL NUCLEAR POWER STATION. Nucl. Newslett. Switz., No. 7, 1-6(Spring 1969).

The operation of the Lucens power plant up to the time of the incident is summarized. The incident occurred during a rise to power following a normal planned shutdown. At a power level of 12 MW(t) the primary circuit pressure fell rapidly, the radiation level in the reactor and reactor cavern rose, and there was an indication of considerable loss of heavy water. The subsequent actions of the operating staff in carrying out the emergency plan, the radioactivity levels measured, and the performance of safety equipment are reviewed. Preliminary speculation on the cause of the incident indicates a pressure tube failure, fuel element overheating, and damage to the moderator tank from excessive pressure. (H.D.R.)

34882 ATUCHA NUCLEAR POWER STATION: A NATURAL URANIUM PHWR IN THE ARGENTINE. Herzog, Gerold B.; Sauerwald, Karl J. (Kraftwerk Union AG., Erlangen, Ger). Nucl. Eng. Int., 14: 485-92(June 1969).

Details are given of the site and the plant layout, and of the design of the reactor, including a description of the refueling system and a table of reactor parameters. The turbo-generator plant, electrical equipment, and control instrumentation are considered briefly. Advantages of D_2O reactors are discussed. (UK)

34883 SIX YEARS OPERATING EXPERIENCE OF THE WINDSCALE ADVANCED GAS COOLED REACTOR. Barton, L. (United Kingdom Atomic Energy Authority, Windscale, Eng.). BNX Rev., No. 3, 51-60(Nov. 1968).

A breakdown is presented of the commissioning time between the start of fuel loading and full power operation, and a detailed analysis is given of the reactor load factor and availability. The design operating conditions are compared with performance in 1963, 1964, and 1968. Operating experience is summarized in relation to fuel performance, gas composition control, refuelling, coolant circuit, boilers, thermal insulation, vibration problems, and loops. Performance of the control and safety system is outlined. (UK)

34884 FUTURE OPERATING ROLE OF NUCLEAR POWER STATIONS. Bainbridge, G. R.; Beveridge, C. (United Kingdom Atomic Energy Authority, Risley, Eng.). Elec. Rev., 184: 864-8(June 13, 1969).

Nuclear power stations will be required and able to operate economically at low load factors in competition with stations using other fuel. For extreme peak lopping, a low capital cost plant such as gas turbines may be more suitable. (auth)

34885 COMPUTER METHODS FOR UTILITY-REACTOR PHYSICS ANALYSIS. Adensam, E. G.; Bell, J. H.; McCullough, H. L.; Raber, M. (Hittman Associates, Inc., Columbia, Md.). Reactor Fuel-Process. Technol., 12: 225-41(Spring 1969).

Many computer codes have been developed to assist the reactor physicist in the design of light-water-reactor cores and the analysis of fuel cycles. Presented is a brief description of the calculation models and computer codes commonly used to obtain cross-section data, reactivity, power distribution, burnup effects, etc. A comparison of computer codes used in each of these areas is made. (auth)

34886 IN-CORE INSTRUMENTATION FOR POWER REACTORS. Phillips, L. E. (Nuclear Associates International Corp., Rockville, Md.). Reactor Fuel-Process. Technol., 12: 195-204 (Spring 1969).

Recent developments and experience with in-core instrumentation for large water-cooled power reactors are reviewed, and the current design practices with respect to in-core instrumentation by the leading water-reactor vendors in the U. S. are related. The operation and applications of radiation detector and thermocouple systems are described for in-core monitoring. (H.D.R.)

34887 REACTOR AND FUEL-PROCESSING TECHNOLOGY. Volume 12, Number 2. One of the Four Technical Progress Reviews Published for the Division of Technical Information, USAEC. Washington, D. C., Atomic Energy Commission, Spring 1969. 132p. GPO $0.70.

Included are 10 articles which review and interpret progress in the areas of reactor and reactor fuel technology. A separate abstract was prepared for each of the 10 articles. (H.D.R.)

For abstracts of individual papers see: 33156, 33249, 33250, 34885, 34886, 34888, 34889, 34905, 34931, and 34947.

34888 RESEARCH AND DEVELOPMENT ON COATINGS FOR RETAINING FISSION-PRODUCT IODINE. Rosenberg, H. S.; Genco, J. M.; Berry, D. A.; Cremeans, G. E.; Morrison, D. L. (Battelle Memorial Inst., Columbus, Ohio). Reactor Fuel-Process. Technol., 12: 115-25(Spring 1969).

The basic chemistry of coatings used as iodine scavengers is discussed. The criteria for a coating to function as a passive safety system is stated. Chemical reactions between candidate coatings and elemental iodine and CH_3I were studied both in the vapor state and under condensing-steam conditions, and deposition rates, capacities, and degrees of irreversibility were noted. Ex-

periments showed that it is possible to form charge-transfer complexes and ammonium salts between amine-containing polymers and elemental iodine and methyl iodide, respectively, under the conditions postulated for serious water-cooled-reactor accidents. Amine-containing polymers are shown to be amenable for fabrication into film-forming pigmented coatings that are resistant to pressurized steam, gamma radiation, and reactor containment spray solutions. Two applicable coating systems are Genamid 2000–Epon 828 and DMAM-Epon 828 copolymers. (M.C.G.)

34889 CONTAINMENT-SYSTEM DESIGN AND CONSTRUCTION PRACTICES IN THE UNITED STATES. Steigelmann, William H.; Tan, Chen Pang. Reactor Fuel-Process. Technol., 12: 151-72(Spring 1969).

The three basic types of containment systems—full-pressure containment, pressure suppression, and pressure relief—are described and their design and construction options are discussed. Environmental and service conditions on which the containment designs are based are summarized. Design features of steel and concrete structures for pressurized-water and boiling-water plants are reviewed, and construction and testing practices are examined. (H.D.R.)

34890 CALCULATION OF THE QUADRATIC REGULATION AREA OF THE OUTPUT TEMPERATURE OF CO_2 FROM THE A 1 REACTOR. Polak, V. Bull. EGU, No. 3-4, 16-21(1968). (In Czech).

A method of investigating the course of the quadratic regulation area of the control circuit of the output temperature of CO_2 from the A 1 reactor for various defects in the circuit under the conditions of power starting is given. The course is investigated above the plane of the parameters K_p and K_i of the controller of the CO_2 temperature. The calculation is carried out by means of a MINSK 22 automatic digital computer. (UKAEA Info. Bull.)

34891 INVESTIGATION OF TRANSITION PROCESSES IN CONTROL CIRCUITS OF THE A 1 REACTOR ON THE OUTPUT LEVELS 100 PERCENT, 66 PERCENT, AND 33 PERCENT. Stirsky, P. Bull. EGU, No. 3-4, 3-10(1968). (In Czech).

An analysis is presented of the influence of parameters of controllers and detectors on the control processes of the A-1 reactor for the output levels 33 to 100%. The influence of parameters of the thermoelements temperature controller and auxiliary control loop based on the gas flowrate is studied. The analysis has been done with an analog computer. Demands for an adaptive temperature controller are specified. (UKAEA Info. Bull.)

34892 PARAMETERS OPTIMIZATION OF NEUTRON DENSITY CONTROL CIRCUIT. Stirsky, P. Bull. EGU, No. 2, 1-6(1968). (In Czech).

The influence of the proportional, integral and time constants of neutron density controller and mean life of prompt neutrons on the control process of neutron density and on performance quadratic criteria, are discussed. An analytical expression for the integral quadratic performance criterion of the neutron density process is deduced and its magnitude for the two-group kinetics of the nuclear reactor is calculated. Transient characteristics of the neutron density for disturbances on required neutron density and on the reactivity for various constants of the controller and the prompt neutron's mean life are given. Linear approximation solutions and an investigation of the influence of main controller's parameters on the neutron density control process in the nuclear power plant A-1 are given. (UKAEA Info. Bull.)

34893 BEZNAU–DOETTINGEN NUCLEAR STATION. Baden, Switzerland, Nordostschweizerische Kraftwerke AG, 1968. 19p.

A description of the Beznau Power Reactor Unit 1 is presented. Topics described include: site; primary plant; secondary plant; auxiliaries; main transformers, 220 kv lines; electrical auxiliary plant; control room; automatic equipment; subsidiary installations; and operation of the plant. (D.C.C.)

34894 RHEINSBERG NUCLEAR POWER STATION. Ackerman, G.; Geisthardt, A. Energietechnik, 18: 292-7(July 1968). (In German).

The Rheinsberg nuclear power station has a pressurized water reactor rated at 265 MW(t) and 70 MW(e) and has 3 loops with water at 100 kp/cm^2 heated from 250 to 263°C. In the secondary circuit 470 t/h of steam are generated at 32 kp/cm^2 and 236°C. Difficulties were experienced with the turbine operating on saturated steam. With its second fuel charge about 5000 MWd/t has been reached. (UKAEA Info. Bull.)

34895 DETERMINATION OF REACTIVITY EFFECTS AND EFFICIENCIES OF THE CONTROL RODS BY DYNAMIC REACTIVITY MEASUREMENTS IN THE RHEINSBERG NUCLEAR POWER PLANT. Mueller, A. (VEB Kernkraftwerksbau, Berlin); Zenker, W.; Frach, K.-H.; Loth, K.-H.; Scheifler, W. Kernenergie, 12: 88-92(Mar. 1969). (In German).

Zero-power experiments at the Rheinsberg Power Reactor have successfully been carried out by using the technique of dynamic reactivity measurement. The variation of reactivity in time is determined by evaluating the time behavior of neutron flux. This may be caused by varying various parameters as the temperature, the fission product poisoning, the concentration of boric acid, or the position of the control rods, the time behavior of which has also been measured. The evaluation of these measurements gives information about the reactivity coefficients or effects, the efficiencies of the control rods, and their integral or differential variation with height of withdrawal. Knowledge of the reactor's physical characteristics for a certain state of burn-up may essentially be extended by using boric acid to balance the reactivity. The results obtained are of great value for revising the methods of calculation. 5 references. (auth)

Power Reactor Development

34896 (GA-8356) HTGR BASE PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING NOVEMBER 30, 1967. (Gulf General Atomic, Inc., San Diego, Calif.). Dec. 29, 1967. Contract AT(04-3)-167. 136p. Dep. CFSTI.

BARIUM—diffusion in graphite at high temperatures
BARIUM ISOTOPES Ba-140—diffusion in coatings on fuel particles
CARBON—barium-140 diffusion in coatings on fuel particles
—radiation effects on dimensions, crystal structure, and properties of, fast neutron
CESIUM—sorption on graphite at low concentrations
FISSION PRODUCTS—behavior of gaseous, in HTGR systems
—diffusion in coatings on fuel particles
—release from silicon carbide coated fuel particles during postirradiation annealing
GAMMA RADIATION—buildup factors in graphite and iron, effects of source energy on
—buildup factors for homogeneous materials, effect of atomic number on
GRAPHITE—gamma buildup factors for, effects of source energy on
—sorptive properties for cesium at low concentrations
—barium diffusion in HTGR, at high temperatures
—radiation effects on dimensions, crystal structure, and properties of, fast neutron
HIGH TEMPERATURE LATTICE TEST REACTOR—reactivity temperature coefficients for first lattice in, (T)
IRON—gamma buildup factors for, effects of source energy on
NEUTRONS, FAST—effects on graphite dimensions, crystal structure, and properties
PRESSURE VESSELS—stress analysis for prestressed concrete reactor
REACTOR FUELS—reprocessing of HTGR, conceptual methods for
—coatings for particle type, uranium content in carbon
—coatings for particle type, fission product diffusion in
—radiation testing of coated particle type, under simulated HTGR conditions
—fission product release from silicon carbide coated particles during postirradiation annealing
—fabrication of HTGR, conceptual methods for
REACTOR LOADING MACHINES—design parameters for 1000 MW(e) HTGR concept
REACTOR, GAS COOLED—design parameters for 1000 MW(e) HTGR concept, cost analysis of
—physics calculation methods for HTGR type, development of
—physics measurements on HTGR Lattice Assembly 1
—stability of 1000 MW(e) HTGR, effect of xenon oscillations on
—transient tests on HTGR, preliminary calculations on proposed Transient Simulation Assembly for
SILICON CARBIDES—electric resistivity of vapor deposited
—radiation effects on vapor deposited
—barium-140 diffusion in coatings on fuel particles
STRONTIUM—deposition on metal surfaces in HTGR systems
URANIUM—content in carbon coatings on fuel particles, effect of coating application temperature on (H.D.R.)

34897 (WASH-1090) EVALUATION OF ALTERNATE COOLANT FAST BREEDER REACTORS. (Alternate Coolant Task Force). Apr. 1969. 154p. Dep. GPO $1.75.

The specific fast breeder reactor concepts using coolants other than Na are assessed in detail. Four reactor designs are considered: three cooled by steam at 1250, 2650, and 3700 psi, and

the fourth cooled by He. The relative value of the concepts are evaluated from the standpoint of technical feasibility, economic potential, and fuel utilization performance. Both concepts were concluded to be technically feasible, to be capable of breeding ratios of interest, and to present no major safety problems. 41 references. (H.D.R.)

34898 PERSPECTIVE FOR THE DEVELOPMENT OF NUCLEAR CENTERS IN FRANCE. Energ. Nucl. (Paris), 11: 7-16(Jan.-Feb. 1969). (In French).

The overall French program for the development of nuclear power plants is discussed. Economic and industrial aspects are considered. The five year development plan which was adopted for plant development is evaluated. The light water, natural uranium-graphite-gas, heavy water, and enriched uranium reactor concepts are discussed. (M.L.S.)

Kinetics and Dynamics

34899 (ANL-7529) DYNAMIC ANALYSIS OF LIQUID-METAL-COOLED FAST POWER REACTORS. DeShong, J. A. Jr. (Argonne National Lab., Ill.). Jan. 1969. Contract W-31-109-eng-38. 90p. Dep. CFSTI.

The small-signal dynamic behavior of liquid-metal-cooled fast power reactors is analyzed by means of feedback control theory. Transfer functions to calculate dynamic feedback reactivity generated by fuel expansion, sodium void effect, and thermal motion of control rods are developed, as well as a computer program to calculate dynamic feedback reactivity produced by thermomechanical distortion and movement of the core fuel elements. A theoretical block diagram of the EBR-II reactor system is constructed from these elements. 13 references. (auth)

34900 (ORNL-TM-2496) NUCLEAR REACTOR CORE ANALYSIS CODE: CITATION. Fowler, T. B.; Vondy, D. R. (Oak Ridge National Lab., Tenn.). July 1969. Contract W-7405-eng-26. 172p. Dep. CFSTI.

A manual describing the use of the machine program CITATION is presented. Other sections are included which present auxiliary information, considerations in application and mathematical formulation. This code is intended to be a generalized computer code for analysis of nuclear reactor cores with treatment of one to three space dimensions. It has been organized to treat a wide variety of different types of calculations using an IBM-360/91 or an IBM-360/75 computer with bulk storage, or any equivalent computer with at least 3×10^5 directly-addressable words. Given such required data as broad-group microscopic neutron-nuclide reaction cross sections, depletion, dynamics, or static problems may be solved. The program is written in FORTRAN 4. (auth)

34901 (ORNL-TM-2571) THEORETICAL DYNAMIC ANALYSIS OF THE MSRE WITH ^{233}U FUEL. Steffy, R. C. Jr.; Wood, P. J. (Oak Ridge National Lab., Tenn.). July 1969. Contract W-7405-eng-26. 42p. Dep. CFSTI.

A study undertaken to characterize the dynamics of the ^{233}U-fueled MSRE prior to operation revealed that the system is inherently asymptotically stable at all power levels above zero. The motivation for these studies was the expected difference between the MSRE dynamic response with ^{233}U fuel and with ^{235}U fuel because of the smaller delayed-neutron fraction of ^{233}U. An existing system model, previously verified for ^{235}U fuel, was modified for use in this work. The reactor system response to reactivity perturbations is rapid and nonoscillatory at high power, and it becomes sluggish and oscillatory at lower powers. These characteristics were determined by three methods: transient-response analyses, including a check of the validity of the linear model; a frequency response and sensitivity study; and stability analyses, both by inspection of the system eigenvalues and by application of the recently developed, modified Mikhailov criterion. 11 references. (auth)

34902 STABILITY OF A PULSED FAST REACTOR. Vaughan, R. A. (Univ. of Birmingham, Eng.). J. Nucl. Energy, 23: 299-303(May 1969).

An existing treatment of pulsed fast reactor kinetics is re-examined and developed to give a stability criterion relating both positive Doppler and axial expansion coefficients of reactivity to the pulsing reactivity insertion. A modification to the previous results is presented, but in general it agrees with a numerical analysis of the original problem. The results show that for a particular reactor there exists a maximum value of the Doppler coefficient above which the system is unstable. The value of this maximum Doppler coefficient is independent of the reactivity insertion. (auth)

34903 WIDE-RANGE REACTOR POWER MEASUREMENT WITH FIXED POSITION DETECTOR. Mogil'ner, A. I.; Morozov, S. A. At. Energ. (USSR), 26: 491-3(1969). (In Russian).

Reactor power measurement method by utilizing both the individual pulses from the fission chamber and statistical fluctuation signal is considered. It is shown that the usual pulse apparatus after some changing can provide the reactor power measurement in a wide range. Experimental results of reactor power measurements are given. 5 references. (auth)

34904 EFFECT OF RANDOM MEDIA UPON NEUTRON TRANSPORT. Barrett, P. R.; Thompson, J. J. (Univ. of New South Wales, Australia). Nukleonik, 12: 159-62(May 1969).

The effect of randomness in the boiling region of a reactor coolant channel upon neutron intensity attenuation factors is examined. The randomness of the medium is assumed to be Gaussian in nature. It is shown that the randomness introduces significant changes in the calculations of intensity attenuation factors, particularly for slug flow boiling conditions. (auth)

Control Systems

Refer also to abstract 33574.

34905 THERMOMETRY FOR FAST BREEDER REACTORS. Shepard, R. L. (Oak Ridge National Lab., Tenn.). Reactor Fuel-Process. Technol., 12: 205-16(Spring 1969).

The U. S. Atomic Energy Commission's (AEC) program for development of liquid-metal fast breeder reactors (LMFBR) will require sensors that can measure sodium coolant temperatures from 420 to 1100°C reliably for 1 year in a fast-neutron flux of 10^{16} neutrons/(cm^2)(sec). Mixed-oxide fuel-pin centerline temperatures of 2300 to 2750°C and fuel-pin cladding temperatures to 1100°C must be measured in fuel-development studies. Commercially available, sheathed, type K thermocouples are being evaluated to meet reliability requirements for routine coolant-temperature monitoring in LMFBR plants. High-temperature W-Re thermocouples are being developed for fuel-pin temperature measurement. New techniques and instruments are being studied as alternative means for overcoming some of the basic limitations of thermocouples and thus assuring accurate, safe, reliable, and economical instrumentation for the fast breeder reactor. (auth)

Fuels

34906 FAST REACTOR IRRADIATION TESTING. Nucl. Eng. Int., 14: 494-502(June 1969).

The main problems associated with fast reactor fuel elements are outlined. A summary is given of the fast-flux irradiation facilities, experience, and programmes of each of the major nuclear countries. (UK)

34907 FUEL ELEMENT PROBLEM WITH STEAM COOLED FAST BREEDER. Ergaenzung, Eine; Fischer, M. (Kernforschungszentrum, Karlsruhe, Ger.). Atomwirt., Atomtech., 14: 263(May 1969). (In German).

The effects of steam system pressure on fuel cycle and power production costs are evaluated. Overall efficiency and core diameter, height, and volume are shown as functions of superheater temperature for the ENEA reference-design steam cooled reactor. Effects of using inner-ribbed fuel elements are evaluated. (M.L.S.)

Auxiliary and Emergency Systems

34908 (DUN-SA-101) COMPUTATION OF TEMPERATURE SENSOR RESPONSE CHARACTERISTICS USING ANALYSIS OF TRANSIENT TEMPERATURE INFORMATION. Leventis, A. A. (Douglas United Nuclear, Inc., Richland, Wash.). May 15, 1969. 15p. (CONF-690609-17). Dep. CFSTI.

From 15th Annual Meeting of the American Nuclear Society, Seattle, Wash.

A description of resistance temperature detectors (RTDs) which are used for temperature input signals to reactors is given. Response characteristics and methods of determining these are discussed. The mathematical model for describing the impulse response of the RTD is formulated; procedures for obtaining the driving function are outlined. A sample problem is included; data are shown graphically. (M.L.S.)

Operation and Economics

34909 BRIEF COMPARISON OF NUCLEAR POWER STATIONS. Leo, B. Energ. Nucl. (Paris), 11: 33-5(Jan.-Feb. 1969). (In French).

Comparisons among different thermal and nuclear power stations, or more generally between any two industrial plants, involves comparing initial costs, as well as operating costs. These two types of expenditure are not the same in character, but they can be linked by the idea of the capitalization rate, which makes

it possible to work out the capitalized overall expenses. It is possible to design diagrams which enable one to read, easily and quickly, the factors of comparison among different installations and thus to assess their relative advantages. Diagrams are included which show very directly the effect of the capitalization rate on the various comparisons. (auth)

34910 THE 15TH ANNIVERSARY OF WORLD'S FIRST NUCLEAR POWER PLANT. Konochkin, V. G.; Kochetkov, L. A.; Minashin, M. E.; Sever'yanov, V. S. At. Energ. (USSR), 26: 487-90(1969). (In Russian).

Operating experiences for the Obninsk Power Reactor components for the period of 15 years are presented (graphite blocks, pipelines, steam generators, pumps). The gamma radiation dose of pipelines and equipment after the plant's 15-year operation is presented. Specific activity of deposits in pipelines caused by isotopes ^{60}Co, ^{54}Mn is $(2 + 6)\ 10^{-7}$ k/cm^2. It is concluded that periodical decontamination of the reactor primary circuits is required. 4 references. (auth)

Safety and Siting

Refer also to abstract 33381.

34911 (GA-9232) RESPONSE SPECTRUM APPROACH TO EARTHQUAKE RESPONSE OF NUCLEAR POWER STATION APPENDAGES. Wesley, D. A. (Gulf General Atomic, Inc., San Diego, Calif.). Apr. 25, 1969. Contract AT(04-3)-633. 17p. (CONF-690609-20). Dep. CFSTI.

From 15th Annual Meeting of the American Nuclear Society, Seattle, Wash.

A method is presented whereby the response spectrum of an appendage system may be generated once the dynamic response characteristics of a primary system subjected to seismic excitation are known. The response spectrum accounts for the dynamic amplification of the appendage as well as the dynamic feedback to the primary system, and thus makes it possible to determine the dynamic response of multidegree of freedom component systems without resorting to the solution of the complete mathematical model of the combined appendage and primary structures. The method is based on the solution of a two degree of freedom system subjected to a random base excitation and is general to the extent that the seismic excitation may be approximated by an equivalent band-limited white noise input at each primary response modal frequency. Results obtained by this method compare favorably with those obtained from a solution of the complete system. A further advantage of the method is that it can provide results when the complete system becomes unmanageably large for present-day computers. 7 references. (auth)

34912 ON THE MEASUREMENT OF FISSION IODINE AFTER A REACTOR ACCIDENT. Glantz, H.; Heinrich, B.; Kiefer, H. (Kernforschungszentrum, Karlsruhe, Ger.). Kerntechnik, 11: 255-7(May 1969). (In German and English).

An experiment designed to clarify at what time after the release of fission iodine into the surroundings in a reactor accident it is possible to determine ^{131}I directly and quantitatively on an I_2 air filter is described. The results showed that even 4 to 5 hours after the release it was impossible to segregate ^{131}I quantitatively from the short-lived I isotopes on the γ spectrum (recorded with a Ge(Li) detector). In the first few hours after the release of fission I_2, the activity component of ^{131}I in the total activity of the released I isotopes can therefore be determined only indirectly, provided the irradiation and the release conditions are accurately known. (auth)

34913 REACTOR ACCIDENT IN LUCENS. Atomwirt., Atomtech., 14: 266-8(May 1969). (In German).

Details of the Lucens Reactor accident are given. The observations of operations personnel, immediately following the shutdown, are recorded. Preliminary efforts on assessing the extent and causes of the accident are described. (M.L.S.)

Power Conversion Systems

34914 CLOSED-CYCLE GAS TURBINE FOR USE WITH A NUCLEAR REACTOR. Burylo, P. (English Electric Co., Ltd., Whetstone, Eng.). Nucl. Energy, 70-4(May-June 1969).

The principles of closed-cycle gas turbines are discussed. Aerodynamic properties of gases are considered. Mechanical and economic aspects as applied to an integrated gas turbine/nuclear reactor system with one common working fluid are examined. (auth)(UK)

Research and Test Reactors

Refer also to abstracts 33479, 33948, 34057, 34491, 34492, and 34906.

34915 (AAEC/TM-496) THEORETICAL CALCULATIONS AND COMPARISON WITH EXPERIMENTAL RESULTS ON BeO-^{235}U AND BeO-ThO_2-^{235}U ASSEMBLIES AT THE CENTRE OF A LOW POWER REACTOR. Cripps, P. B. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr. 1969. 51p. Dep.

Reactivity and integral and differential spectrum measurements were compared with calculations on a series of ^{235}U fueled, BeO and BeO-ThO_2 moderated assemblies placed within the internal reflector of the low power reactor MOATA. Five assemblies were studied: three BeO-^{235}U assemblies with atom ratios of 740/1, 1120/1, and 2185/1, and two BeO-Th-^{235}U assemblies with atom ratios of 750/1.8/1 and 1500/3.6/1. Good agreement was found between the experimental and calculated neutron spectrum and fission ratios. There exists a discrepancy between the measured and calculated reactivity effects. 15 references. (auth)

34916 (ANL-7282, pp 1-13) EXTERNAL BEAMS AND COINCIDENCE FACILITIES. Shera, E. B. (Los Alamos Scientific Lab., N. Mex.).

Three facilities for providing beams of thermal neutrons external to the reactor are described. Various methods used for separating the fast and slow neutrons and for γ shielding are discussed. The coincidence facility at Los Alamos, which is being used with an external beam to develop low-lying level schemes of daughter nuclei, is described. The facility uses a Ge(Li) detector to view the high-energy primary transitions that populate the low-lying levels and a NaI detector to watch the levels decay. (H.D.R.)

34917 (ANL-7282, pp 43-55) INSTALLATION AND USE OF AN INTERNAL-TARGET FACILITY. Thomas, G. E. (Argonne National Lab., Ill.).

The design and installation of an internal-target facility at a tangential through hole at the Argonne CP-5 reactor are described. Measurement procedures on capture-γ-ray spectra using Ge(Li) detectors are described, and sample spectra for Fe and C are presented. (H.D.R.)

34918 (ANL-7282, pp 449-58) THE BNL FAST-CHOPPER FACILITY AT HFBR. Chrien, R. E.; Palevsky, H. (Brookhaven National Lab., Upton, N. Y.).

The BNL fast chopper was designed specifically for the purpose of observing neutron-capture γ rays in resonances in the lower range of epithermal neutron energies. The assembly of the chopper in the H-2 radial beam tube of the High Flux Beam Reactor is described, and its operating characteristics are discussed. Some typical spectra obtained with the facility are presented. (H.D.R.)

34919 (BNWL-1067) NUCLEAR PARAMETERS AND PARAMETRIC STUDIES FOR THE FAST TEST REACTOR (FTR). Little, W. W. Jr.; Maas, L. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). June 1969. Contract AT(45-1)-1830. 43p. Dep. CFSTI.

The principal neutronics characteristics of the vertical FTR reference reactor are described. Since the design has not been frozen, selected parametric studies are also included to show the effect of design changes. 3 references. (auth)

34920 (KFK-939) THE INFLUENCE OF NUCLEAR DATA UNCERTAINTIES ON PROPERTIES OF CRITICAL ASSEMBLIES. Broeders, C. H. M. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Jan. 1969. 19p. (EUR-3956). Dep.

The influence of the uncertainty of ^{238}U capture cross section and ^{235}U fission cross section on the design parameters of steam-cooled fast reactors is analyzed. Fundamental mode calculations for two critical assemblies are presented: the SNEAK 3A-2 uranium fueled assembly with soft neutron spectrum; and the ZPR 3-48 plutonium fueled assembly with hard neutron spectrum. 6 references. (auth)

34921 (ORNL-tr-1938) REPORT OF BLIND STARTUP EXPERIMENTS ON THE CABRI REACTOR ON JULY 4-8, 1966. Filipczak, Nadejda; Filipczak, Wieslaw; Furet, Jacques; Kaiser, Josef (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Translated by R. Gregg Mansfield and Betty Montgomery (Oak Ridge National Lab., Tenn.), from report CEA-R-3341. 18p. Dep. CFSTI.

Description of a MAXTREL type blind startup method for the CABRI Reactor is presented. (D.C.C.)

34922 (RT/FI-(69)14) CALCULATION OF SPECIFIC POWER IN SEVERAL MOCK-UPS IRRADIATED IN THE RITMO REACTOR.

Conversano, R.; Cosoli, G.; Valle, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1969. 19p. (In Italian). Dep.

Irradiations of two series of mockups containing, respectively, UO_2 rods, 25% enriched in ^{235}U, and B_2O_3 natural UO_2 rods with the same macroscopic absorption cross section have been carried out in the central cavity of the RITMO reactor at CNEN, Casaccia. The calculation method of the specific power generated in the mockups is described. 4 references. (auth)

34923 INTERPRETATION OF PULSED SOURCE MEASUREMENTS BY THE MOMENTS METHOD. Rotter, W. (CEN, Mol, Belgium). J. Nucl. Energy, 23: 289-98(May 1969).

The amplitude and the phase behavior of the prompt transfer function for slow frequencies, derived from pulse experiments, lead to a simple calculation of moments from which the decay constant of the fundamental mode, the amplitude of the delayed neutron tail, and a harmonic correction factor for the area ratio of Sjöstrand can be found. The high sensitivity on the presence of harmonics makes this method very useful for checking the fitting results. Obviously, the moment method is not limited to pulsed neutron experiments. It can be applied to other experiments, which are governed by a single decay constant. (auth)

34924 ENERGY SPECTRUM OF THE GAMMA RADIATION IN THE DAPHNE CORE. Silk, M. G. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Energy, 23: 308-13 (May 1969).

The use of an in-pile γ-ray spectrometer for the measurement of the spectrum in a reactor is discussed. Experiments are described using a Li-drifted Si detector. The initial γ-ray spectrum was obtained by unfolding techniques tested previously. The detector, enclosed in an Al can 2 mm thick, had a sensitive area of 2 mm^2. Results of measurements in the DAPHNE core at 25 and 50 mW are presented. Good agreement was found with theoretical results from 0.2 to 3.25 MeV, the experimental range. (UK)

34925 IN-PILE OPERATION OF A THERMIONIC CONVERTER. Jester, A. (Brown, Boveri und Cie AG, Mannheim, Ger.); Marth, W. Kerntechnik, 11: 265-8(May 1969). (In German and English).

The experiment succesfully demonstrated the static conversion of nuclear into electric energy. A thermionic converter was in operation for 3750 h in an in-pile irradiation experiment and in that time generated 260 kWh of electric power, corresponding to an average power of 70 W. Further long term experiments of this type are in preparation. 5 references. (auth)

34926 PULSED EXPERIMENTS ON THE FAST SUBCRITICAL INSTALLATION AT KARLSRUHE (SUAK) AND COMPARISON OF RESULTS WITH CALCULATIONS. Mitzel, F.; Schroeter, K. E. (Kernforschungszentrums, Karlsruhe, Ger.). Nukleonik, 12: 110-17(Mar. 1969). (In German).

Measurement of prompt neutron decay constants effective multiplication factors, and neutron lifetime in the fast subcritical assembly at Karlsruhe (SUAK) is discussed. The assembly, experimental setup, and measurements are described. Core physical dimensions and atom densities are tabulated. Measured eigenvalues are compared with calculated values. (M.L.S.)

34927 MEASUREMENT OF FISSION DENSITY DISTRIBUTIONS WITHIN FUEL ELEMENTS IN THE VICINITY OF GREY ABSORBER CONTROL ELEMENTS. Tuyn, Jan W. N. (Institutt for Atomenergi, Kjeller, Norway). Nukleonik, 12: 183-5(May 1969).

Results of measurements of the non-uniform azimuthal variation of the intracell fission density distribution within fuel elements in the vicinity of grey absorber control elements in the NORA reactor are presented. The intracell fission density distributions were measured with the solid state nuclear track detector technique, using Ag-activated phosphate glass as detector material. For direct comparison with theoretical calculations the intracell fission density distribution in a clean lattice is presented too. (auth)

34928 EXPERIMENTS ON HEAVY WATER-MODERATED THORIUM LATTICES IN THE SIEMENS-ARGONAUT REACTOR AND THEIR COMPARISON WITH THEORY. Gruen, Arnold E.; Mueller, Albert; Ruebenberg, Patrick; Schlosser, Gerhard (Siemens Aktiengesellschaft, Erlangen, Ger.). Nukleonik, 12: 168-75(May 1969). (In German).

Resonance absorption measurements in heavy water moderated Th lattices in the Siemens-Argonaut reactor are described; methods used for analytically determining the neutron spectra and fluxes are outlined. Critical mass and neutron leakage factors are discussed; the procedures in determining these parameters are described. Values for two-group absorption rates are tabulated for Th in quasihomogeneous lattices; experimental and theoretical values for the absorption rates are compared graphically. (13 references) (M.L.S.)

Rocket and Space Reactors

34929 (ORNL-TM-2532) MODIFICATIONS TO THE MONTE CARLO CODES USED TO CALCULATE POWER DISTRIBUTION AND NEUTRON LEAKAGE FROM THE TSF-SNAP REACTOR. Franz, K. D.; Cain, V. R. (Oak Ridge National Lab., Tenn.). June 12, 1969. 136p. Dep. CFSTI.

Earlier calculations of power distribution and neutron leakage from the TSF-SNAP reactor assumed a small amount of Be uniformly distributed throughout the core and that the reactor control drums were fully inserted. These calculations were repeated with the distributed Be removed, a central cylinder of Be inserted and with two of the four control drums rotated out 30°. Listings are given of all the necessary changes in computer programs and their inputs. 4 references. (auth)

Process Heat and Desalination Reactors

34930 PROGRESS REPORT ON PROGRAM ROVI. Di Menza, Raffaele (CNEN, Rome). Com. Naz. Energ. Nucl., Notiz., 15: 42-5(May 1969). (In Italian).

The main specifications of the ROVI reactor are listed. Economic and technical considerations are made on this design, with estimates as to the progress of the program. 5 references. (auth)

Marine and Portable Power Reactors

Refer also to abstract 34027.

34931 POSTOPERATIVE STUDIES OF PM-1 AND PM-3A FUEL TUBES. Brown, John B. Jr.; Storhok, V. W. (Battelle Memorial Inst., Columbus, Ohio). Reactor Fuel-Process. Technol., 12: 134-50(Spring 1969).

The Portable Medium Power Plant 3A (PM-3A) type 1, serial 2 core was discharged at 53% of the core's design lifetime primarily because of increasing fission-product accumulation in the primary coolant system, presumably resulting from a fuel leak of undetermined origin. The Portable Medium Power Plant 1 (PM-1) type 1, serial 3 core also experienced an increasing fission-product accumulation in the primary coolant but was permitted to operate to 100% of the core's design lifetime. Coolant fission-product activity buildup was believed to be associated with defects in 347 stainless-steel cladding on the tubular-type fuel; the fuel consisted of 28 vol. % UO_2 dispersed in 304L stainless steel. Both PM cores were examined to locate and establish the nature of the fuel-tube defects and to determine the cause of such defects. Results of the core examinations showed that fuel-tube failures were similar in both PM reactors. Fission products leaked through numerous intergranular cracks in the outer cladding of fuel tubes located in the high-performance region of the cores, where burnups exceeded 13 to 14×10^{20} fissions/cm^3. The cracks started on the outer surface of the cladding and generally terminated at UO_2 particles near the fuel dispersion cladding interface. All cracks in the outer cladding were longitudinal and were associated with hoop strains greater than about 0.3%. No cracks were observed in the tubes' inner cladding of fuel matrix. On the basis of mechanical-property data of irradiated stainless steel, it is possible to attribute the failures solely to fuel swelling and effective cladding ductility losses associated with neutron exposure, low-strain-rate biaxial loading, and thermally induced cyclic loading. However, the similarity of the PM cladding failures to stress-corrosion cladding failures observed in boiling-water reactors suggests the possibility that the PM failures are related to the same type of stress-corrosion cracking as the boiling-water-reactor cladding. (auth)

Reactor Theory

34932 (KAPL-P-3811) ANOMALY ARISING IN THE COLLAPSED-GROUP FLUX SYNTHESIS APPROXIMATION. Adams, C. H.; Stacey, W. M. Jr. (Knolls Atomic Power Lab., Schenectady, N. Y.). June 17, 1969. Contract W-31-109-Eng-52. 10p. (CONF-690609-12). Dep. CFSTI.

From 15th Annual Meeting of the American Nuclear Society, Seattle, Wash.

An anomaly arising from a flux-weighted collapsed-group synthesis calculation for an annularly-rodded cylindrical core is discussed. Results from using expansion functions as weighting

shapes are described; these results are compared with actual values. Behavior of the calculated fluxes is analyzed; reasons for the behavior of the flux anomaly are explained. 11 references. (M.L.S.)

34933 (KAPL-P-3830) TWO-DIMENSIONAL BLACKNESS THEORY BOUNDARY CONDITIONS: RZ GEOMETRY. Mendelson, M. R.; Storm, M. L.; Gazda, S. A. (Knolls Atomic Power Lab., Schenectady, N. Y.). [1969]. Contract W-31-109-Eng-52. 15p. (CONF-690609-9). Dep. CFSTI.

From 15th Annual Meeting of the American Nuclear Society, Seattle, Wash.

A procedure is described for obtaining boundary conditions for a finite cylinder consisting of arbitrary scattering and absorbing material for use in few-group diffusion theory R–Z cell calculations. The method relies on a definition of an albedo function which relates the incident and exit currents on the surface of a body. A discrete spatial mesh is superimposed on the surface to yield a set of albedo matrices. Application of the definitions of partial currents to the albedo matrices results in the desired diffusion theory boundary conditions. Examples of the procedures and results are included. 10 references. (M.L.S.)

34934 (MIT-3903-1) NUMERICAL SOLUTION OF THE TWO-DIMENSIONAL TIME-DEPENDENT MULTIGROUP EQUATIONS. McCormick, William T. Jr.; Hansen, Kent F. (Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering). May 1969. Contract AT(30-1)-3903. 78p. (MITNE-99). Dep. CFSTI.

A numerical algorithm for the solution of the two-dimensional time-dependent multigroup neutron diffusion equations is presented. The method assumes that the variation in the neutron flux at each mesh point can be represented as an exponential function of time over each integration time step. Additionally, the assumption is made that the transverse leakage in one spatial direction can be approximated by a pointwise transverse buckling over one time step. These assumptions, together with an appropriate factoring and integration of the matrix form of the semi-discrete multigroup equations, produce a mathematically consistent approximation and an unconditionally stable algorithm. It is also shown that the asymptotic numerical solution is proportional to the asymptotic eigensolution of the semi-discrete multigroup equations. The experimentally observed truncation error is discussed and several numerical experiments are presented which illustrate the accuracy and utility of the method. 18 references. (auth)

34935 (MIT-3903-2) FINITE DIFFERENCE TECHNIQUES FOR THE SOLUTION OF THE REACTOR KINETICS EQUATIONS. Reed, William H.; Hansen, K. F. (Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering). May 1969. Contract AT(30-1)-3903. 87p. (MITNE-100). Dep. CFSTI.

A class of finite difference methods called splitting techniques are presented for the solution of the multigroup diffusion theory reactor kinetics equations in two space dimensions. A subset of the above class is shown to be consistent with the differential equations and numerically stable. An exponential transformation of the semidiscrete equations is shown to reduce the truncation error of the above methods so that they become practical methods for two-dimensional problems. A variety of numerical experiments are presented which illustrate the truncation error, convergence rates, and stability of a particular member of the above class. 18 references. (auth)

34936 (RPI-328-156) SEMI-ANALYTIC FLUX REPRESENTATION FOR FAST PULSED ASSEMBLIES. Daitch, P. B.; Knickle, H. N. (Rensselaer Polytechnic Inst., Troy, N. Y.). [1969]. Contract AT(30-3)-328. 2p. (CONF-690609-14). Dep. CFSTI.

From 15th Annual Meeting of the American Nuclear Society, Seattle, Wash.

A calculational model for neutron flux calculations for fast pulsed assemblies is given in functional form. Assumptions made to arrive at an expression for the decay constant are summarized. The model is also extended to weakly multiplying systems. (M.L.S.)

34937 ANALYSIS OF COUPLED CORE REACTORS USING THE NATURAL MODE APPROXIMATION. Betancourt, Joaquin Manuel. Ames, Iowa, Iowa State Univ., 1968. 109p.

Thesis.

A space dependent reactor kinetics approximation, called the natural mode approximation, is used to solve the space-time kinetic equations for coupled-core nuclear reactors. In this formulation the space and time dependent neutron fluxes and other dependent variables of the reactor system are approximated by a series of products of unknown time dependent coefficients and known spatially dependent expansion vectors. The analysis includes time domain and frequency domain investigations. Numerical calculations are carried out for a one-dimensional three-region unreflected coupled-core reactor and for a one-dimensional model of a coupled-core Argonaut type reactor. Results of the analysis of space dependent effects due to oscillation tests are compared with independent results in which the Green's function modes are the basis functions. (Diss. Abstr.)

34938 ANALYZING NEUTRON COUNT TRIOS INTO TWO- AND THREE-FORKED COMPONENTS. Furuhashi, Akira. (Tokyo Inst. of Tech.). J. Nucl. Sci. Tech. (Tokyo), 6: 156-8 (Mar. 1969).

Determination of the prompt neutron multiplication factors from the observation of correlated neutron triplets is discussed. Use of a double-gated counting apparatus is described. The generating function for the counting probability is defined. Methods for determining the number of correlated triplets are outlined; methods for determining the magnitude of the triplet components are indicated. (M.L/S.)

34939 NEUTRON DENSITY VERSUS FLUX WITH REGION-AVERAGED SPECTRA. Bonalumi, R. (Laboratori CISE, Milan). Energ. Nucl. (Milan), 16: No. 5, 53-6(May 1969).

A procedure for a simplified two-region thermal spectrum calculation is detailed. The multienergy first-collision probability method is used to obtain expressions for the neutron flux, disadvantage factors, and reaction rates. Assumptions made to arrive at these approximate forms are delineated. (M.L.S.)

34940 A COMMENT ON THE DEAD-TIME-α (FIRST MOMENT) METHOD. Teodosic, Vlada (Danish Atomic Energy Commission, Risoe). Nukleonik, 12: 187-8(May 1969).

Use of the paralyzable gate for Rossi-α measurements is discussed. Application of the dead-time method to Rossi-α measurements for higher counting rates is described. (M.L.S.)

34941 AN ANALYSIS OF THE ACCURACY OF MEASUREMENTS OF REACTOR PARAMETERS BY AUTO- AND CROSS-SPECTRUM STUDIES. Teodosic, Vlada (Danish Atomic Energy Commission, Risoe). Nukleonik, 12: 185-7(May 1969).

An analysis of variances of the periodogram estimators as well as of the smoothed estimators shows that the cross-spectrum method is equivalent to the autospectrum method in the case of equal detector efficiencies only if a constant filter bandwidth is used to measure all regions of both spectra. If a relatively wide filter is used to measure the high-frequency region of the autospectrum, the autospectrum method exhibits a slight advantage over the cross-spectrum method. In the case of unequal detector efficiencies the autospectrum method always offers a better accuracy than the cross-spectrum method. (auth)

34942 SOLUTION OF THE SPACE–TIME DEPENDENT NEUTRON KINETICS EQUATIONS FOR A REFLECTED SLAB REACTOR. McFadden, James Hugh. Ames, Iowa, Iowa State Univ., 1968. 100p.

Thesis.

A modal analysis technique is used to solve the space-time and space-frequency dependent neutron diffusion equations for a reflected slab reactor. A two-energy-group model is employed and delayed neutron effects are neglected in the solutions of the time dependent equations. The neutron flux is expanded in a series of known space functions multiplied by the corresponding time coefficients. The space functions are a form of the Green's function modes and the Kantorovich variational method is used to determine the time coefficients. A coupled mode method is applied to two time dependent problems. Approximate solutions are determined by various sets of trial functions and are compared with an exact solution as determined by a finite difference code. The frequency response of the reactor to a localized driving function also is investigated. Solutions are obtained with four sets of trial functions, of which two sets include coupled modes, and are compared at various detector positions in the fuel and reflector regions. Guides are given for the selection of trial functions based on the locations in the reactor where the frequency response is to be determined. (TSS)

Experimental Applications

34943 (RISO-M-897) SCANDINAVIAN REACTOR PHYSICS CO-OPERATION ON POINT AND CELL BURN-UP CODES. BURN-UP CALCULATIONS FOR D_2O REACTORS. Micheelsen, B. (Danish Atomic Energy Commission, Risoe. Research Establishment). May 7, 1969. 37p. Dep.

The results of a number of point and cell burn up programs used in Scandinavia have been compared. The comparison was made for three types of heavy water reactors. 8 references. (auth)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 33309–33311, 33343, 33344, 33354, 33567, 33922, 33941–33945, 33966, 33967, 33972, 33973, 33983, 34022, 34024, 34036, 34037, 34056, 34058, 34059, 34070, 34073–34079, 34083, 34084, 34098, 34117, and 34118.

34944 (ANL-7411(Suppl.2)) ARGONNE CODE CENTER: COMPILATION OF PROGRAM ABSTRACTS. Butler, M. K.; Legan, Marianne; Ranzini, L. (Argonne National Lab., Ill.). Apr. 1969. Contract W-31-109-eng-38. 188p. Dep. CFSTI.

A bibliography of computer program abstracts referring to available computer programs at the Argonne Code Center is presented. (D.C.C.)

34945 (CONF-680625-8) SOME ASPECTS OF NUCLEAR PLANT EQUIPMENT. Pulford, K. B. (English Electric Co. Ltd., Whetstone (England). Reactor Equipment Div.). [1968]. 22p. Dep.

From BNX/BNF Nuclear Power Meeting, Copenhagen, Denmark.

The design and manufacture of some items of British nuclear plant equipment are reviewed, and related to the needs of other reactor systems. Reliability, accessibility for maintenance, fault analysis, and emergency procedures are considered. Examples chosen include calandrias, rotating shields, control and mechanisms, and liquid shut-down system components. (UK)

34946 (TRG-Report-1836) SIMPLE MODEL FOR ESTIMATING THE BOW OF FUEL ELEMENTS AFTER COMPLETE STRESS RELAXATION. Anderson, R. G. (United Kingdom Atomic Energy Authority, Springfields (England). Reactor Group). Feb. 20, 1969. 22p. Dep. CFSTI. UK 3s. 0d.

A model for estimating the bow of fuel elements after complete stress relaxation by creep is used to survey the range of possible final shapes of a simple structure. Some illustrations of fuel element bowing are given to illustrate the different concepts. It is found that the initial deflections can be substantially altered both in magnitude and direction. The methods developed are also applicable to a wide range of structural problems where additional deflections during stress relaxation are important. 16 references. (auth) (UK)

34947 MECHANICAL ANALYSIS OF FISSION-GAS SWELLING OF CLAD CYLINDRICAL FUEL ELEMENTS. Walowit, J. A.; Adler, W. F.; Chubb, W. (Battelle Memorial Inst., Columbus, Ohio). Reactor Fuel-Process. Technol., 12: 126-33(Spring 1969).

A mathematical model is presented in an attempt to describe the radial, fission-gas swelling of high-temperature, clad cylindrical fuel elements. The creep resistances of both the fuel and the cladding are taken to provide the principal modes of restraint. The fuels considered are UC and UN at a temperature of 1700°C. Assumptions in the model are that a uniform distribution of a large number of pores exists within the fuel and that temperatures and fission rates are independent of position. The effects of gas release are considered by means of various gas-release vs. porosity relations as input. Creep is treated in terms of the usual power law relation between stress and strain rate. A number of parametric studies are presented to show the effects of different cladding thicknesses, initial porosities, creep strengths, and gas-release relations on predicted swelling. Comparisons between theoretical predictions and experimental data are given. Good qualitative agreement between theory and experiment is obtained. Quantitative agreement can be obtained if the fuel creep strengths used are somewhat lower than those measured out of pile. These results support the hypothesis that the fission process weakens the mechanical restraint provided by the fuel. (auth)

34948 NOVEL MOTORS MATCH NUCLEAR REACTOR PUMP NEEDS. Brooks, G. R.; Burke, R. R. Allis-Chalmers Eng. Rev., 33: No. 3, 15-17(1968).

Four 5500 hp, 888 rpm vertical motors are used to drive pumps which circulate water through one reactor. A larger size motor, 9000 hp, 1200 rpm is now being built for this service. As the machine will be in a radioactive, inaccessible location for 2–3 years at a time, maximum attention is given to ensure that nothing will require unscheduled maintenance. A special high temperature coil insulation system with at least 40 years design life in a zone of γ particle radiation of 30 to 100 R/hour has been developed. (UKAEA Info. Bull.)

GENERAL

34949 (AEC-tr-6821) NUKLEONIKA. Translation of Nukleonika, 12: 1081-1222(1967). 153p. Dep. CFSTI.

34950 (AEC-tr-6869/5) UKRAINIAN PHYSICS JOURNAL. Translation of Ukr. Fiz. Zh., 12: No. 5, 705-878(1967). 169p. (TT-67-51421/5; IPST-Cat.-5065). CFSTI.

Seven of the articles appearing in this cover-to-cover translation were selected from the original Ukrainian in 1967, and appear in NSA, Vol. 21, with the following abstract numbers: 32943, 33439, 33630, 33746, 33919, 34053, and 40162. (L.M.T.)

34951 (ANL-7456) THE THERMODYNAMIC PROPERTIES OF As_2, As_4, AND SOME ARSENIC FLUORIDES. O'Hare, P. A. G. (Argonne National Lab., Ill.). Nov. 1968. Contract W-31-109-eng-38. 20p. Dep. CFSTI.

The thermodynamic functions S^0, C_p^0, $H^0 - H_{298}^0$, $(H^0 - H_0^0)/T$ and $(G^0 - H_0^0)/T$ were calculated for gaseous As_4, As_2, and AsF_n (n = 1, 2, 3, 4, and 5) by the formulas of statistical mechanics. In addition, ΔHf, ΔGf, and log Kf values, based on experimental data, are given for As_4, As_2, AsF_3, and AsF_5; the corresponding values were estimated for AsF and AsF_4. The thermodynamic data were tabulated at 100° intervals between 0 and 2000°K, and also at 273.15 and 298.15°K. Some thermodynamic aspects of the arsenic-fluorine system are discussed briefly. (auth)

34952 (ANL-7501) NUCLEAR MAGNETIC RESONANCE SPECTRA IN BINARY MIXTURES OF INORGANIC FLUORIDES. Williams, Lesley L. (Argonne National Lab., Ill.). Aug. 1968. Contract W-31-109-eng-38. 92p. Dep. CFSTI.

Thesis. Submitted to Univ. of Wisconsin, Madison.

The effects of solvent, concentration, and temperature on the chemical shifts, line widths, and spin-spin coupling constants are reported for eight binary liquid inorganic fluoride mixtures from their high-resolution ^{19}F and ^1H nuclear magnetic resonance (NMR) spectra. The mixture systems studied were: IOF_5-WF_6, IOF_5-IF_7, IOF_5-IF_5, IOF_5-BrF_5, IF_5-IF_7, $HF-IF_7$, $HF-IOF_5$, and $HF-BrF_5$. A solvent effect for the IOF_5 line width was found in liquid IF_5 and BrF_5 solutions. For IOF_5 dilute in IF_5 at -15°C, the line width was reduced tenfold, revealing the second-order AB_4 pattern and yielding a fluorine coupling constant of J_{FF} = 284 ± 5 Hz. A similar solvent effect was not observed for IF_7 in the solutions examined, nor for IOF_5 in three other solvents. (TSS)

34953 (COO-773-19) [DETERMINING THE EFFECT OF STRUCTURE AND ENVIRONMENT ON THE RADIATION AND NON-RADIATION PROBABILITIES IN METAL COMPLEXES]. 1968-69 Annual Technical Progress Report, June 16, 1968-June 15, 1969. (Arizona Univ., [Tucson]. Dept. of Chemistry). Contract AT(11-1)-773. 10p. Dep. CFSTI.

Relaxation of ^2E states in Cr(III) complexes, the effect of host lattice on ground-state splittings in chromium complexes, low-temperature spectra, ^2E splitting in tetragonal fields, doublet-doublet absorption from excited states, and polarization of electronic transitions are discussed. (M.C.G.)

34954 (COO-1018-1170) QUARTERLY TECHNICAL PROGRESS REPORT, OCTOBER-DECEMBER 1968. (Illinois Univ., Urbana. Dept. of Computer Science). 225p. (COO-1469-107). Dep. CFSTI.

Topics include circuit research; hardware systems research; computer research; Illinois pattern recognition computer: ILLIAC III; ILLIAC IV; numerical methods, computer arithmetic, and artificial languages; switching theory and logical design; SOUPAC section; IBM system/360 service; IBM 7094/1401 service, use, and development; and general department information. (W.H.K.)

34955 (COO-1018-1174) THE PAX II PICTURE PROCESSING SYSTEM AT THE UNIVERSITY OF ILLINOIS PROGRAMMING MANUAL. Borovec, Richard T. (ed.) (Illinois Univ., Urbana. Dept. of Computer Science). Mar. 18, 1969. 107p. Dep. CFSTI.

PAX II, a collection of subroutines in FORTRAN for processing pictorial information, is presented. This is a revised and expanded version of PAX which stimulates the "pattern articulation unit" of the ILLIAC III computer which can perform operations in parallel on digitized pictures stored in two-dimensional registers. PAX II has been implemented on the IBM 7094, IBM 360, and Univac 1108 computers. (W.H.K.)

34956 (HMI-B-80) ANNUAL REPORT, 1968. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). May 1969. 217p. (In German). Dep.

Research progress is reported in the following areas: nuclear chemistry, mathematics, nuclear physics, radiation chemistry, electronics, reactors, and radiation physics. (M.C.G.)

34957 (LA-4051) SOME INEQUALITY RELATIONSHIPS CONCERNING POWER SUMS AND THE ELEMENTARY SYMMETRIC FUNCTIONS. Hundhausen, Joan H. (Los Alamos Scientific Lab., N. Mex.). Nov. 7, 1968. Contract W-7405-eng-36. 7p. Dep. CFSTI.

Inequality relationships between the power sums and the elementary symmetric functions of a finite set of nonnegative real variables are reduced from consideration of some classical results. Comparability relations between pairs of selected elementary symmetric functions are also demonstrated. (auth)

34958 (LA-4137) COMPARISON OF NUMERICAL QUADRATURE FORMULAS. Kahaner, David K. (Los Alamos Scientific Lab., N. Mex.). Mar. 1, 1969. Contract W-7405-eng-36. 13p. Dep. CFSTI.

Several methods for general purpose numerical quadrature are considered. Selection criteria are total time, including bookkeeping time and function evaluation time, and accuracy of the estimate. The effectiveness of several new methods has been compared with the adaptive Simpson's rule and under certain circumstances at least two of these new methods perform better. (auth)

34959 (LA-4141) THE METHOD OF ODD/EVEN REDUCTION AND FACTORIZATION WITH APPLICATION TO POISSON'S EQUATION. Buzbee, B. L.; Golub, G. H.; Nielson, C. W. (Los Alamos Scientific Lab., N. Mex.). June 5, 1969. Contract W-7405-eng-36. 32p. Dep. CFSTI.

Several algorithms are presented for solving block tridiagonal systems of linear algebraic equations when the matrices on the diagonal are equal to each other and the matrices on the subdiagonals are all equal to each other. It is shown that these matrices arise from the finite difference approximation to certain elliptic partial differential equations on rectangular regions. Generalizations are derived for higher order equations and non-rectangular regions. (auth)

34960 (NYO-906-85) PREPARATION AND STRUCTURAL STUDIES OF SOME TRANSITION METAL CHELATES OF FUROYL-TRIFLUOROACETONE. McSharry, William O. (Fordham Univ., New York. Dept. of Chemistry). 1969. 91p. Dep. CFSTI.

Thesis.

Chelates of the general formula $NH_4M^n(FTA)_{n+1}$, where M is a metal of valence n and FTA is 4,4,4-trifluoro-1-(2-furyl)-1,3-butanedione, were prepared with Mn(II), Fe(II), Co(II), Ni(II), Cu(I), Zn(II), and Cd(II). An attempt to prepare a similar compound with Cu(II) produced only the normal chelate. The crystal and molecular structure of $NH_4Cd(FTA)_3$ was determined from approximately 700 three-dimensional x-ray film data. The compound crystallizes in space group $R\bar{3}$ with six molecules per unit cell. Cell dimensions are a and b = 18.46(3) and c = 14.68(2) Å. The structure consists of ammonium ions and cadmium atoms placed alternately along the three-fold axis with the three essentially planar bidentate ligands arranged symmetrically about the cadmium. The ligand oxygens appear to interact with both the Cd and the NH_4. The N-O distances for the two crystallographically nonequivalent ammoniums are 2.92 and 2.93Å, while the Cd-O distances are 2.21 and 2.25Å. The structure was refined by least squares to a conventional crystallographic weighted R factor of 7.0%. Powder patterns of the other tris chelates indicate similar structures to the cadmium chelate. Infrared spectra of the compounds are similar to those of normal acetylacetonates and show a relationship between stability constant and frequency for certain bands. The ultraviolet spectra of all the tris chelates are almost identical. Visible spectra are quite anomalous with respect to both intensity and frequency of absorption. (auth)

34961 (NYO-906-86) MOESSBAUER EFFECT INVESTIGATION ON TIN BONDING. Kazimir, Edward O. (Fordham Univ., New York. Dept. of Chemistry). May 23, 1969. 196p. Dep. CFSTI.

Thesis.

The relationship between Moessbauer effect parameters and the bonding of tin in tin-containing molecules is shown. After an exposition of the UNIXTL and PDRHXT programs, magnetic field (50 kgauss) data are presented for $(CH_3)_2SnF_2$. This data established that the electric field gradient in $(CH_3)_2SnF_2$ arises from an imbalance in the 5p orbitals and not from a $d\pi$-$p\pi$ mechanism. This result, however, does not mean that there is no $d\pi$-$p\pi$ bonding. In the presence of a large magnetic field, very small (0.3 mm/sec) and previously undetected quadrupole splittings could be observed.

Two further techniques (oriented sample and the Keryagin-Gol'danskii effect) were employed to determine the sign of the electric field gradient in $(CH_3)_2SnF_2$. Both showed that it is negative as was found in the magnetic field study. The relationship between the molecular geometry of tin-containing molecules and the Moessbauer effect parameters was established. The Moessbauer effect parameters of compounds for which the structure was determined by x-ray diffraction were recorded. The relative magnitudes of these parameters were observed to follow the relative magnitudes predicted by the point charge calculations. A study was done on the N,N-dithiocarbamates. This involved their synthesis, ir, and Moessbauer effect spectra. For the tetrakis compounds, it was shown that $Sn(DEDTC)_4$ and $Sn(DEDTC)_4$ are not eight coordinate but more probably six coordinate. A set of postulated structures for various $R_2Sn(D,N\text{-}DTC)_{4-n}$ compounds based on ir, regular Moessbauer effect, and high-magnetic-field Moessbauer effect measurements is included. These results indicate that the variation of the structures of these compounds is not simple. (auth)

34962 (NYO-2174-80) R/V ATLANTIS II CRUISE NO. 32. SUMMARY CRUISE REPORT. TRACK CHARTS, BATHYMETRY, AND LOCATION OF OBSERVATIONS, NORTH ATLANTIC OCEAN, NORTH SEA, BALTIC SEA, MAY 14–JULY 25, 1967. Bunce, E. T.; Thompson, G. (comps.); Dunkle, W. M. (comp. and ed.) (Woods Hole Oceanographic Institution, Mass.). Dec. 1967. Contract AT(30-1)-2174. 175p. Dep. CFSTI.

Cruise summaries and charts for ATLANTIS II cruise no. 32 in the North Atlantic Ocean, North Sea, and Baltic Sea are presented. Included are 73 charts plotted on a Mercator Projection (scale 1° Longitude equals 4 inches) showing the track of the entire cruise except for parts of the Baltic and Mid-Atlantic Ridge Survey. The types of observations made during the cruise are noted by suitable symbols or legends along the ship's track. Index charts I and II show the overall cruise coverage and survey areas. Index charts III and IV show Baltic Sea Surveys with Stations and Continuous Seismic Profiling. Index chart V shows the general area of the Mid-Atlantic Ridge Survey. Charts VI–VII show the bathymetry and the total intensity magnetic field measurements (in gammas) for the Mid-Atlantic Ridge Survey. Soundings were read at equal time intervals and at each break in slope for the survey. These were entered on the ship's track as often as space permitted. All soundings were based on sound velocity of 800 fathoms/second and were corrected only for depth of transducer. (auth)

34963 (ORNL-TM-2623) PROPOSED NEW INFORMATION CENTERS. Kertesz, Francois (Oak Ridge National Lab., Tenn.). [1969]. 11p. Dep. CFSTI.

Recent proposals are presented concerning the establishment of new information centers: Information Center for Industrial Instrumentation, Matrix Information Center, Information Center for Dosimetry, Research and Development Hazard Control Information Center, Environmental Mutagens Information Center, Molten Salt Breeder Reactor Information Center, Information Center on Fluorine Compounds, Information Center on Analytical Methods for the Nuclear Industry. (auth)

34964 (ORO-3018-44-A) SPECTROSCOPY OF SOME SMALL HIGH SYMMETRY MOLECULES AND OXYANIONS. Brayden, Thomas Harold Jr. (Louisiana State Univ., Baton Rouge). Aug. 1968. 111p. Dep. CFSTI.

Thesis.

The approach to solving the problem involves using certain computational methods and comparing the results obtained with experiment. Some of the shortcomings of the calculational routine are listed and their consequent effect on the reliability of the calculated values is also discussed. The results of the calculational efforts are used to construct quantitative Walsh energy level diagrams and to determine the charge distributions in the molecules/ions studied. The quantitative diagrams were compared with published qualitative Walsh energy level diagrams. Development of these qualitative diagrams using group theory is presented. The charge distributions in the molecules/ions studied were correlated with their lowest-energy electronic transitions. Experimental electronic spectra are presented and the interpretation of these is compared with those available in the scientific literature. Predictions utilizing the quantitative diagrams were made for 18, 24, and 26 electron entities. These predictions were compared with the features of known experimental spectra. Complicating factors, such as the influence of coordinating solvent and/or cation, were introduced. The probable effects were rationalized and investigated using as models some of the possible species present in an aqueous solution of $NaNO_3$. The availability and the energy value of the possible σ^* and π^* levels are related. These attitudes are then discussed in connection with a composite spectrum taken from the literature. Possibilities presented are that the 3000 Å band of an aqueous nitrate solution contains an $n\text{-}\pi$ (forbidden) and an $n\text{-}\sigma^*$ (slightly allowed), while the 2000 Å band contains a $\pi\text{-}\pi^*$ (allowed) and an $n\text{-}\sigma^*$ (allowed). (auth)

34965 (SC-RR-67-656-B) ROLAMITE: A NEW MECHANICAL DESIGN CONCEPT. Wilkes, D. F. (Sandia Labs., Albuquerque, N. Mex.). Mar. 1969. 258p. Dep. CFSTI.

The rolamite geometry, recently developed by Sandia Laboratory, forms an extremely tolerant precision rolling suspension suitable for a wide range of applications and does not require precision tolerance machining to manufacture. Rolamite exhibits coefficients of friction 1 to 10 percent of the values obtained from conventional bearings; no lubrication is required. Rolamite geometry produces axial forces of any desired character. It can provide nearly all the mechanical functions normally discussed in mechanical engineering machine design text books as well as many electromechanical functions. The simplicity of the rolamite geometry enables the design of innumerable complete electromechanical devices composed of only 4 to 10 piece-parts. Sandia Laboratory is developing a modular design suitable for producing a wide range of microminiature weapon components in which one key part provides from 80 to 95 percent of the necessary functions. These parts, to be designed by a computerized process, will be produced by strip-processing by means of high-rate photochemical methods and photo masters which could easily be adapted for mass production. These masters are traced out automatically from machine tool instructions produced during the original computer design process. (auth)

34966 (SC-T-69-1025) DIFFERENCE METHOD FOR INTEGRATING THE BOUNDARY-LAYER EQUATIONS IN THE CASE OF COMPRESSIBLE FLUID FLOWS UNDER CONDITIONS OF EXTERNAL AND INTERNAL PROBLEMS. IN BOOK: CONVECTIVE HEAT TRANSFER. Nikitenko, N. I. Translated by M. I. Weinreich (Sandia Labs., Albuquerque, N. Mex.), from pp 147-59 of Konvektivnyi Teploobmen, Publishing House of the Ukrainian Academy of Sciences, Inst. of Technological Thermophysics, Kiev, 1968. 14p. Dep. CFSTI.

A system of equations for a boundary layer for flow of a compressible liquid along a heated penetrated surface is developed. A specific difference method for solving the equations is developed which shows that in the immediate vicinity of the input cross-section of the channel, a sharp change of the profile of the velocities and of the friction stress on the walls occur. Thereafter, there is a gradual stabilization of flow. (F.S.)

34967 (UCRL-50594) ZONAL GENERAL CIRCULATION MODEL. MacCracken, Michael C. (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 2, 1969. 30p. Dep. CFSTI.

The formulation and results of a numerical atmospheric model that is derived from the model of C. E. Leith but that is based on conservation equations having a flux-divergence form are discussed. The model is simplified by assuming that the longitudinal variations of all parameters are zero, a choice that removes meteorological variations but that permits climatic study. Mountains and an energy balance between land and ocean surfaces are included, and both interact with the atmosphere. The results of this two-dimensional model during a two-year real-time run compare favorably with actual climatology; the exceptions can be related to assumptions in the model. The conservation formulation works as expected, and no averaging is necessary to treat the singular points at the poles. (auth)

34968 (Y-1671) DIGITAL LEAK-RATE GAGE. Gray, D. H. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). June 26, 1969. Contract W-7405-eng-26. 24p. Dep. CFSTI.

An instrument called a digital leak-rate gage was developed for determining porosity and was placed in operation at the Oak Ridge Y-12 Plant. This device will read electronically the position of an indicator float in an air column and provide a direct digital display and card-punch readout. (auth)

34969 DATA EXTRACTION AND PROCESSING OF OPTICAL IMAGES IN THE MEDICAL AND BIOLOGICAL SCIENCES. Conference Held in New York, June 5–7, 1967. Krauss, Marc (ed.). Ann. N. Y. Acad. Sci., 157: 1-530(Mar. 31, 1969). (CONF-670635).

Separate abstracts were prepared on three of the papers presented at the conference. Thirty-seven other papers discuss the techniques and applications of cytophotometry to cytological and cytogenetic studies. (E.R.B.)

For abstracts of individual papers see: 33528, 33808, and 33816.

NOTICE

A title page for Volume 23, Numbers 13–18, is included at the back of this issue for use in binding those issues.

CORRECTIONS

NSA Vol. 21, No. 14, Abst. No. 25478, line 3 should read: 83-84(Feb. 1967).

NSA Vol. 23, No. 6, Abst. No. 9302, line 29 should read: LITHIUM FLUORIDE—KF-LiF-NaF, separation of hydrofluoric acid and

NSA Vol. 23, No. 12, Abst. No. 22620, line 1 should read: (WARD-3791-28) OXIDE FUEL ELEMENT DE-